Comparisons between HIRDLS and ACE-FTS

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and the HIRDLS team

Aura Science Team Meeting
11-15 September 2006

Thanks to Peter Bernath, Chris Boone and Sean McLeod for near real time ACE-FTS data.

Atmospheric Chemistry Experiment Fourier Transform Spectrometer

Launched on the Canadian SCISAT-1 satellite on 12 Aug 2003

IR (2.2 – 13.3 μm) Fourier Transform Spectrometer (0.02 cm^{-1} resolution)

Solar Occultation, 74° Inclination:

- **Near global coverage in ~1 month, but extended periods in polar region**
- **Sunrise/Sunset only**

Vertical resolution: ~4 km

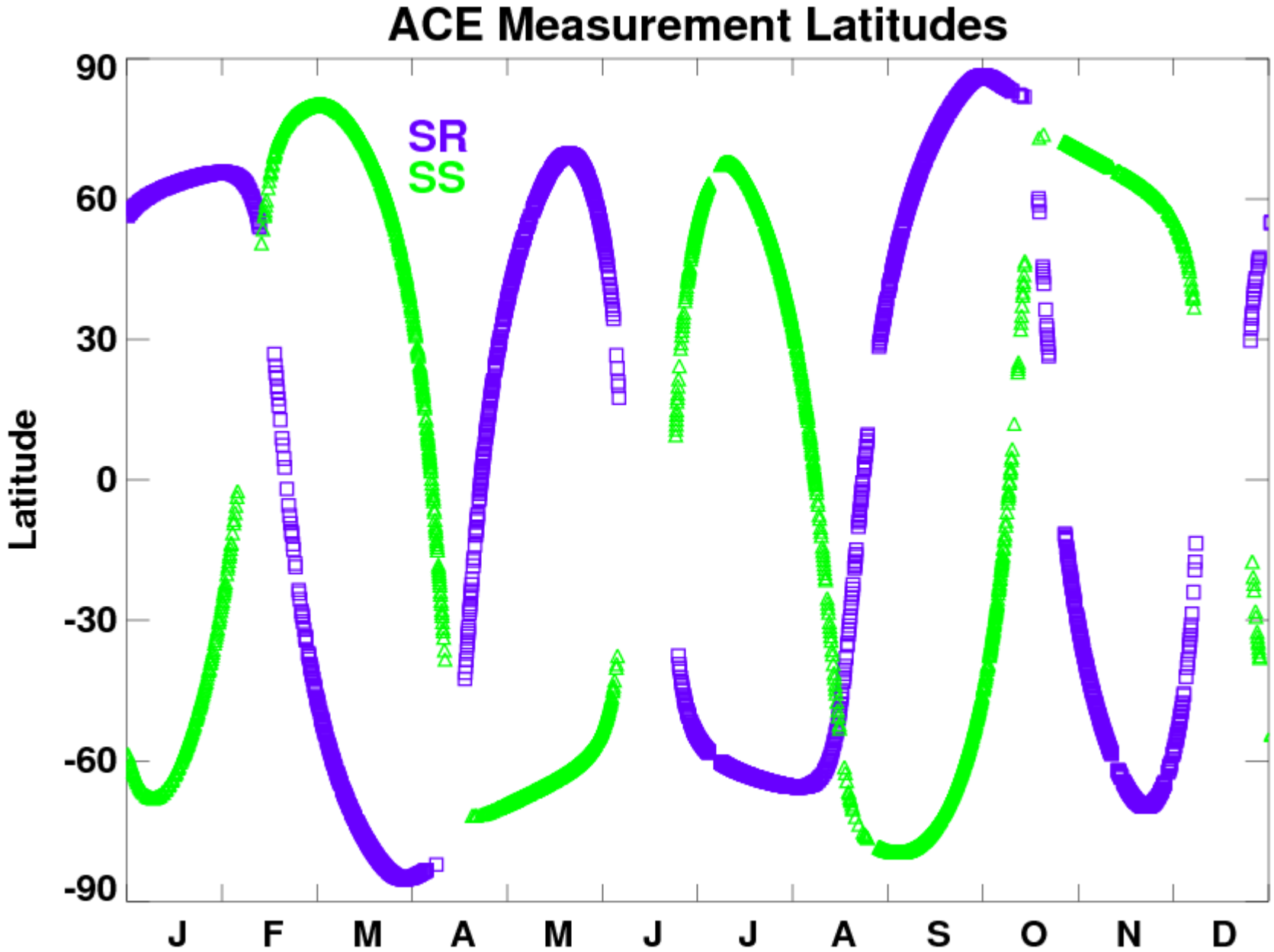
Cloud Top to 150 km

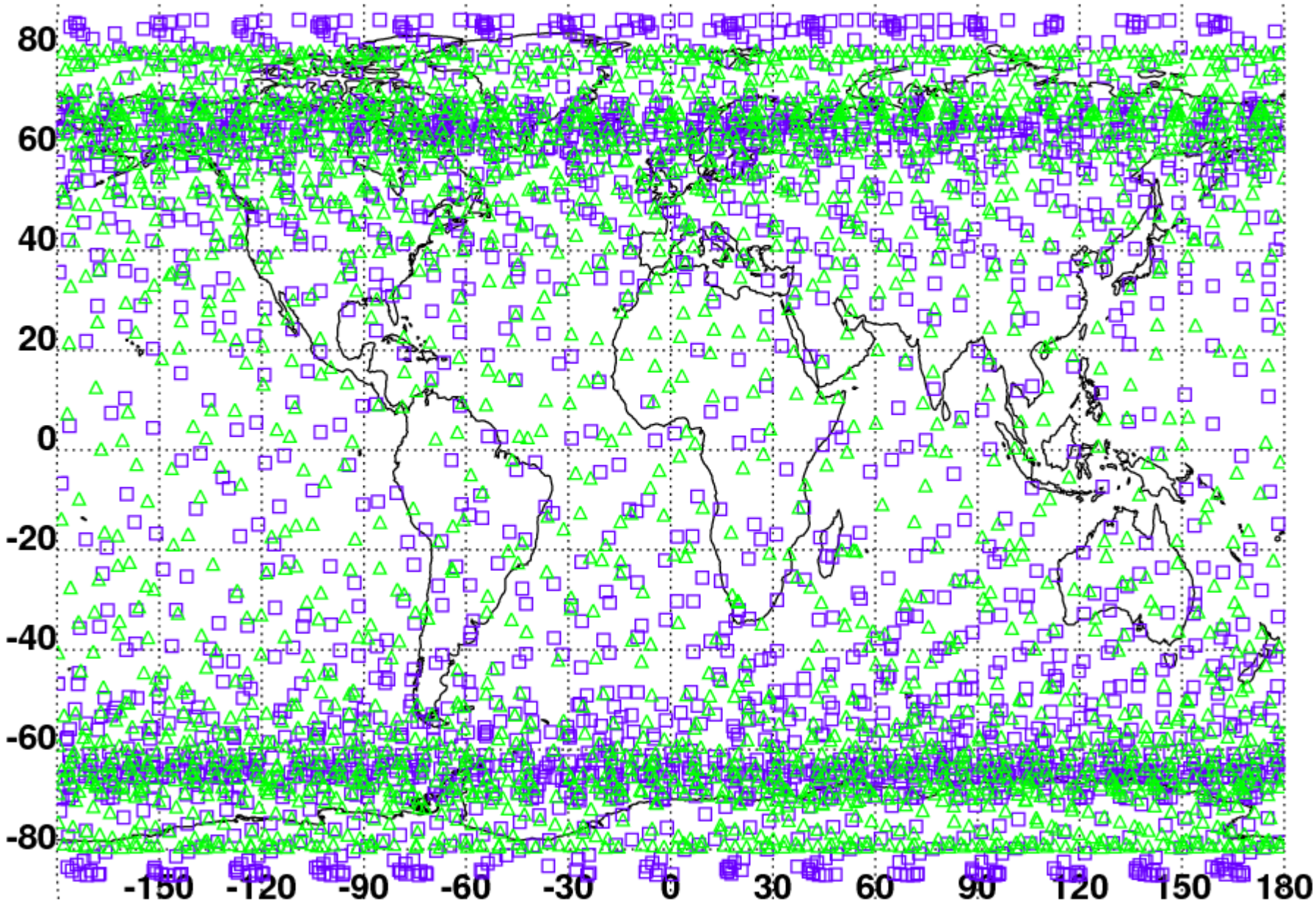
Constituents: P,T,H_2O, O_3, N_2O, CO, CH_4, NO, NO_2, HNO_3, HF, HCl, OCS,N_2O_5, $ClONO_2$, HCN, CH_3Cl, CF_4, CCl_2F_2, CCl_3F, COF_2,C_2H_6, C_2H_2, CHF_2Cl, SF_6, ClO, HO_2NO_2, H_2O_2, HOCl, N_2,cloud/aerosol

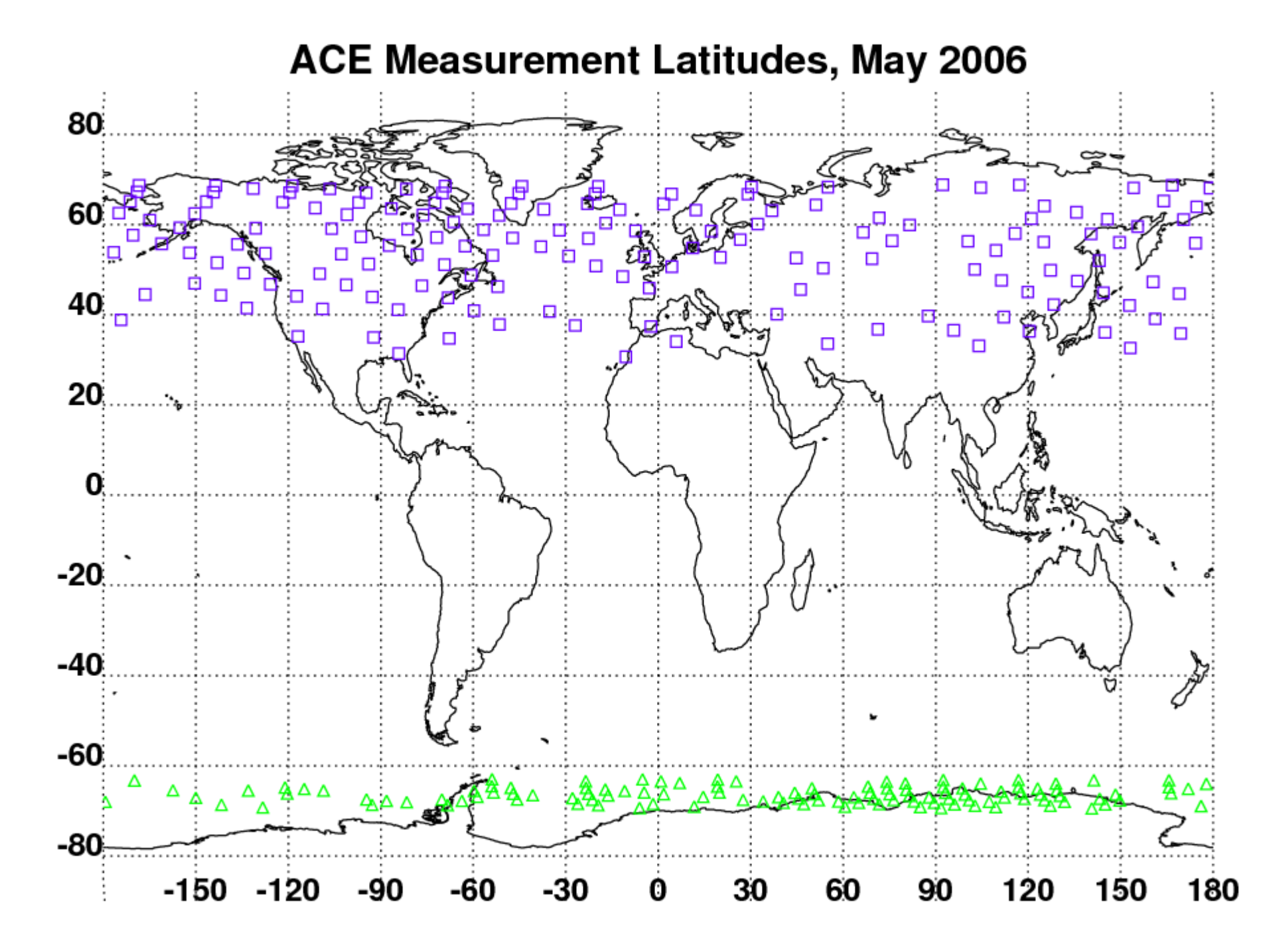
(See GRL special issue, vol. 32, 2005.)

ACE-FTS Validation Status (v1.0)

Ozone	±10%, Solar Occultation, 15-40 km
NO_2	0-10% lower than HALOE, 22-35 km
T	±2 K, HALOE, 35-70 km
H_2O	0-10% higher than HALOE, 20-45 km
CH_4	10% higher than HALOE, 18-55 km
$ClONO_2$	±20% (column, NDSC FTIR)


ACE Measurement Latitudes
SR
SS
Latitude
90
60
30
0
-30
-60
-90
J
F
M
A
M
J
J
A
S
O
N
D


ACE Measurement Latitudes, One Year
80
60
40
20
0
-20
-40
-60
-80
-150
-120
-90
-60
-30
0
30
60
90
120
150
180


ACE Measurement Latitudes, May 2006
80
60
40
20
0
-20
-40
-60
-80
-150
-120
-90
-60
-30
0
30
60
90
120
150
180

HIRDLS vs. ACE-FTS Comparisons

HIRDLS data are version 2.02.

The individual processor versions are:

L1X 6.2.1 L1C 3.2.2 L2PP 4.0.12 L2 1.7.0

HIRDLS data files have names with the following structure:

HIRDLS2ALL_v2.02-c1_2006d115

ACE-FTS data are near-real-time version 2.2.

- Ozone update
- Do *not* use High altitude HNO_3 retrievals because there are not enough retrievals at this time.

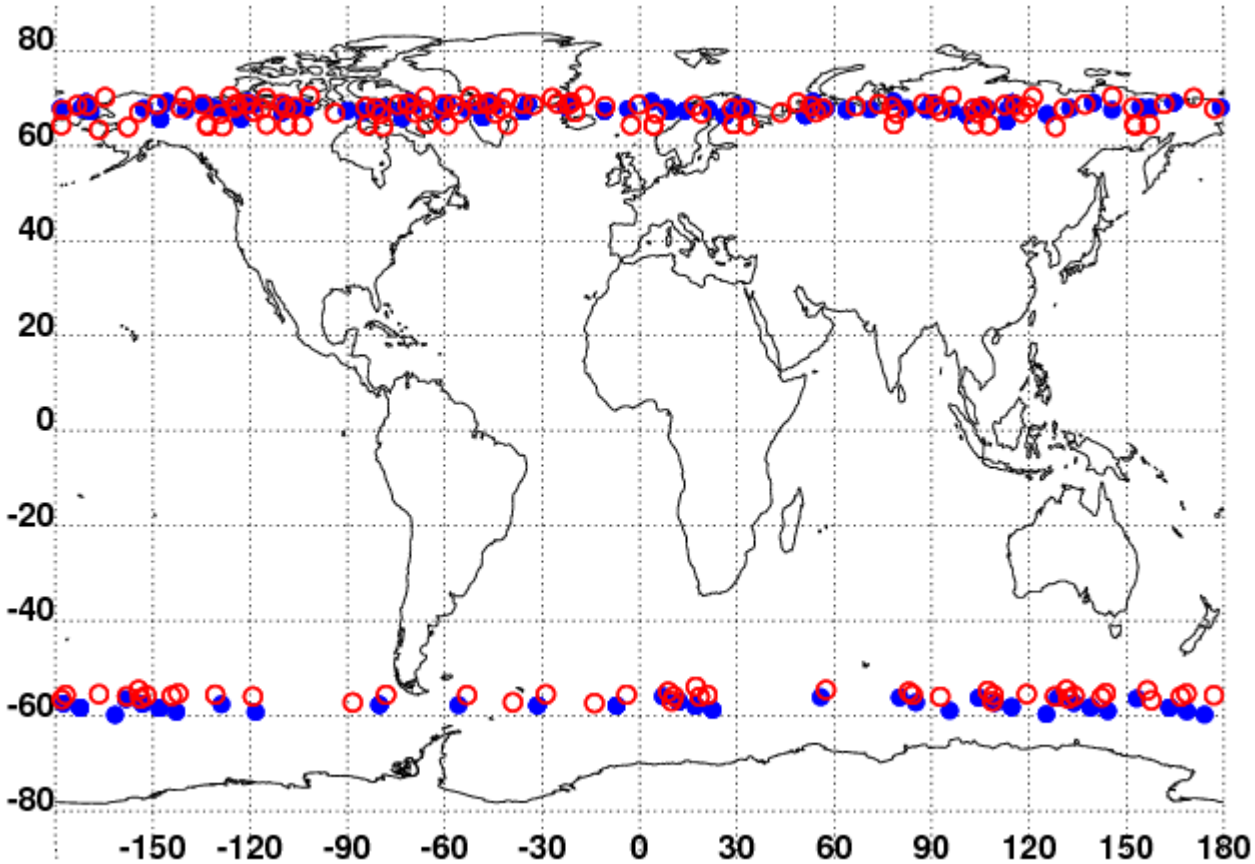
Data Screening

- Omitted HIRDLS data poleward of 63°S.
- Omitted HIRDLS data if precision was negative.
- Omitted ACE-FTS data if too large a contribution from a priori.
- Did not screen ACE-FTS or HIRDLS based on “errors” in data files.

Coincidence Criteria: ±2 hrs, ± 500 km.

All HIRDLS profiles coincident with a single ACE-FTS profile were averaged together before comparing.

HIRDLS/ACE-FTS Coincidences, 18-31 May & 11-13 Jul, 2006



Total of 156 coincidences

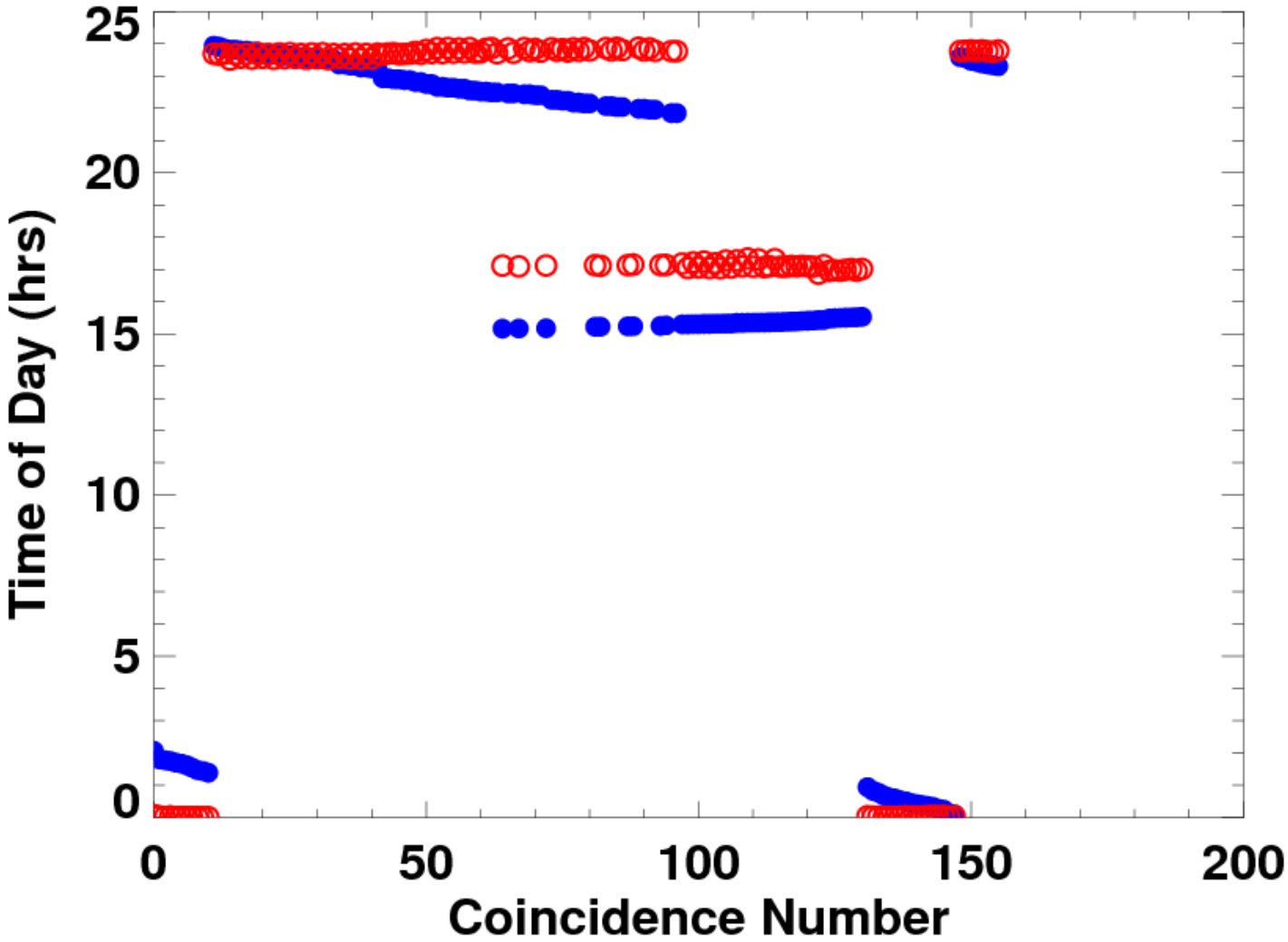
18-31 May 2006
11-13 July 2006

113 in NH
43 in SH

Avg Separation = 302 km, ranging from 37-495 km

Avg Time Diff = 1.1 hrs

HIRDLS/ACE-FTS Coincidences, 18-31 May & 11-13 Jul, 2006



Comparison Slides for Individual Species

HIRDLS and ACE-FTS coincident profiles

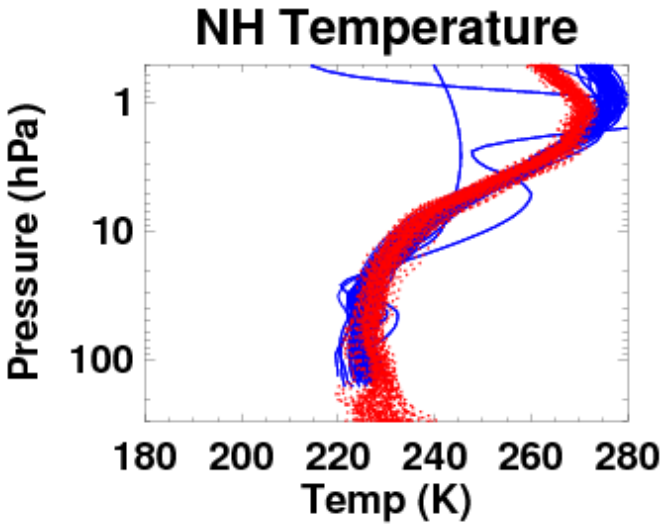
- Plot NH and SH separately
- Overplot all profiles
- Plot average ± 1-σ standard deviation

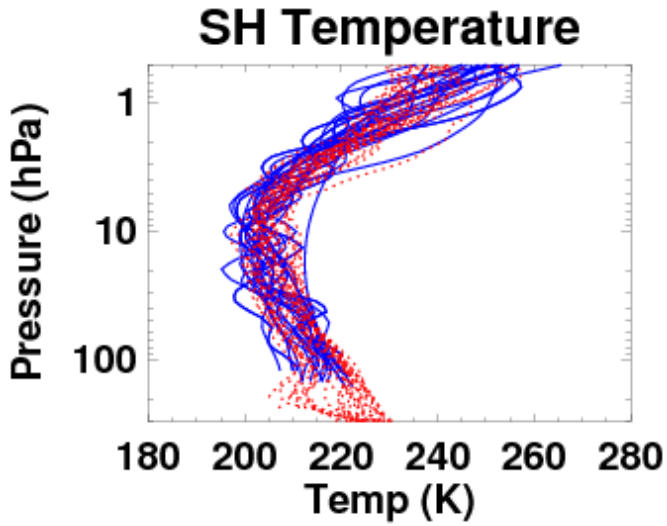
HIRDLS and ACE-FTS difference profiles

- Plot NH and SH separately
- Overplot avg and ± 1-σ standard deviation with all individual differences
- Plot both absolute (mixing ratio) and relative (%) differences

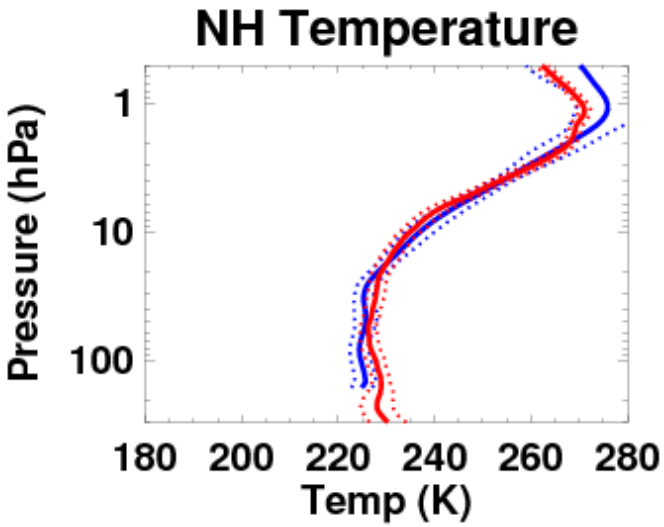
Temperature

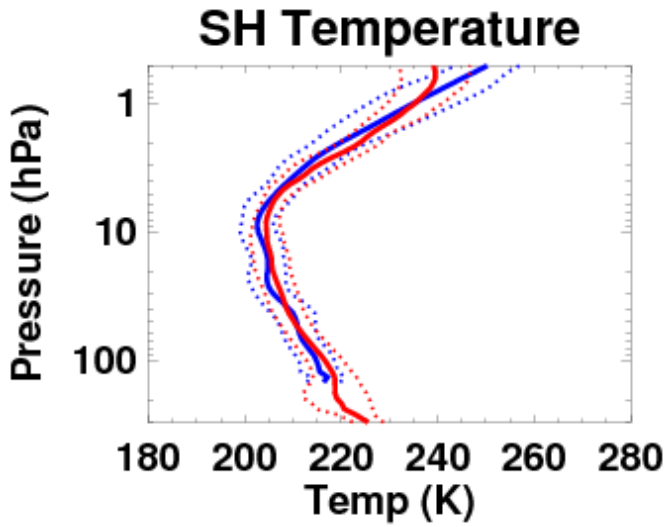
HIRDLS & ACE-FTS Temperature Profiles





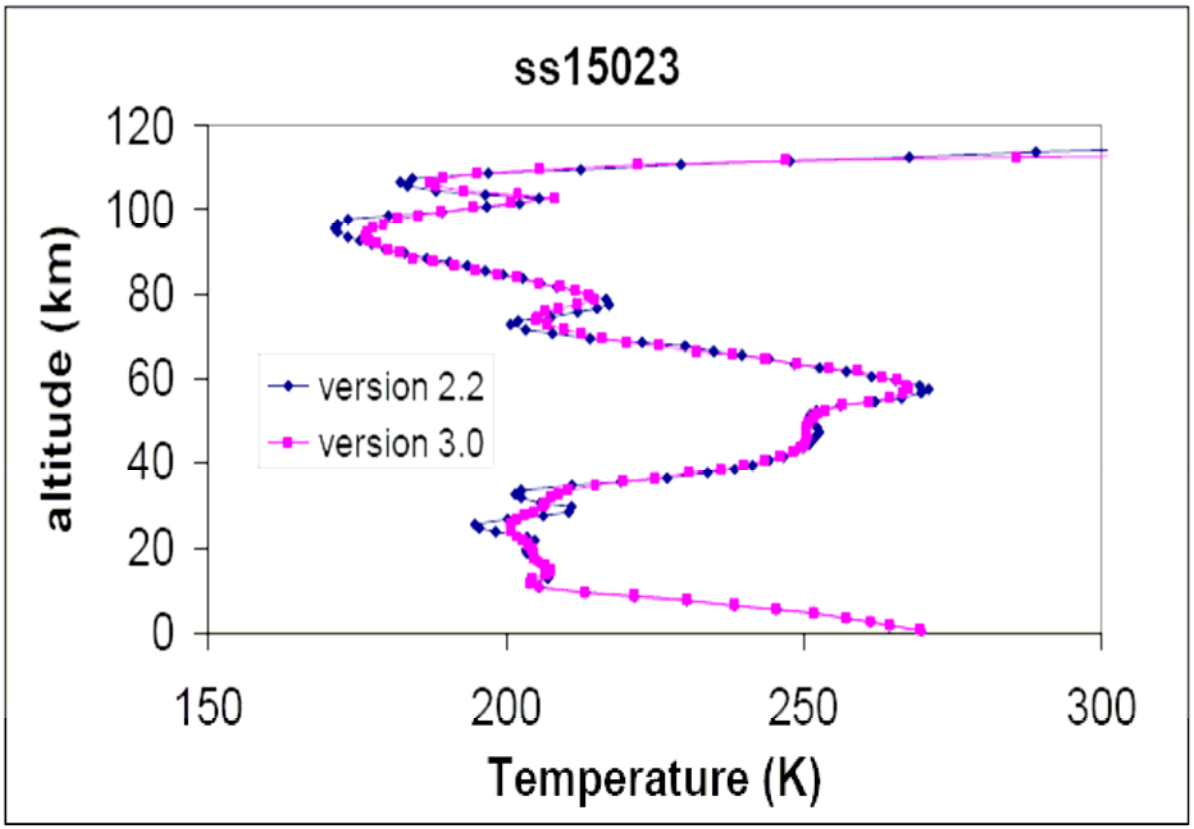
All Coincidences





Average (solid) & 1-σ standard deviation (dotted)

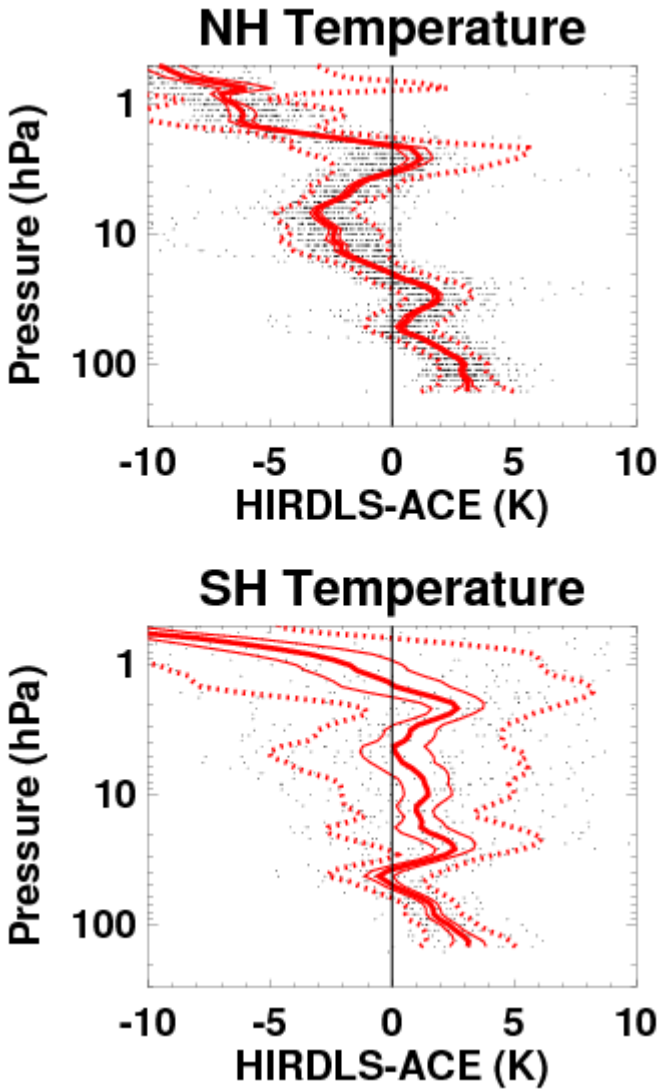
Note: Variability in the ACE-FTS temperature retrievals is a known problem that will be fixed in the next version (3.0) of the retrievals.



Small-scale oscillations have been removed with the newer retrieval algorithm.

Figure courtesy of Chris Boone

HIRDLS-FTS Temperature Differences



Thick red:
Average

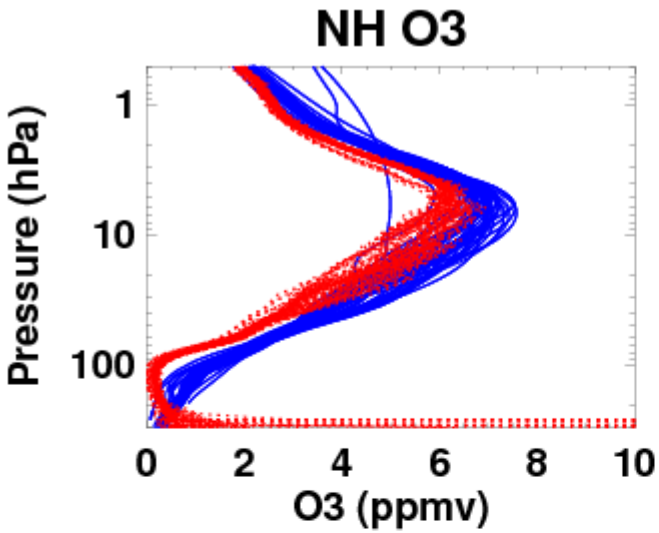
Dotted red:
1-σ distribution

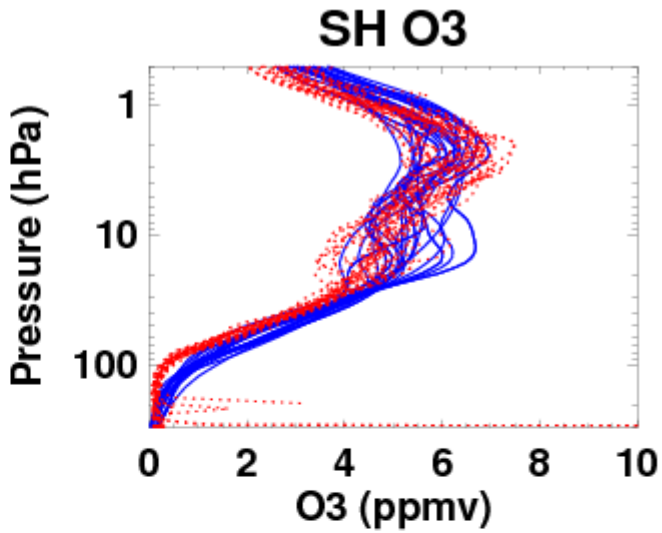
Thin red:
1-σ uncertainty
(often hidden)

Black points:
Individual
differences

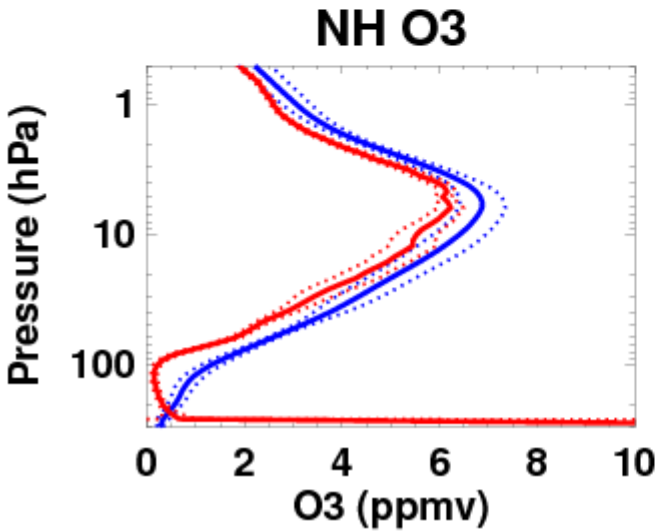
Ozone

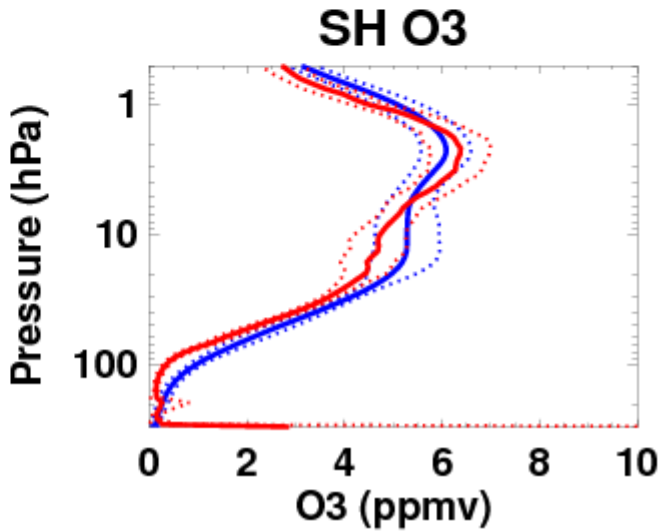
HIRDLS & ACE-FTS Ozone Profiles





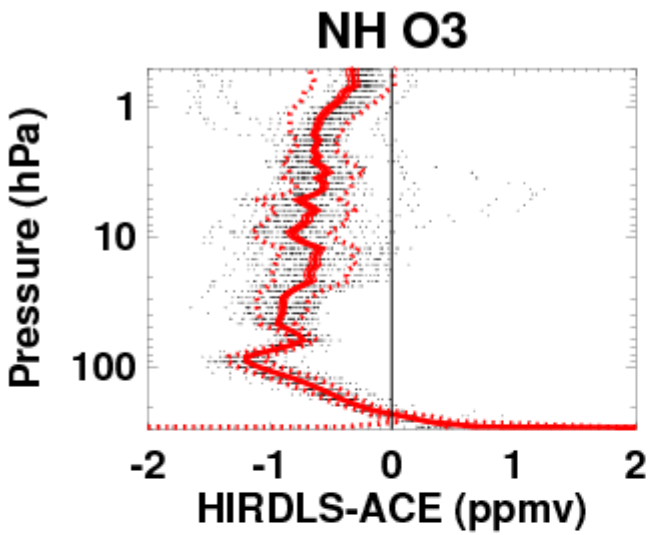
All Coincidences

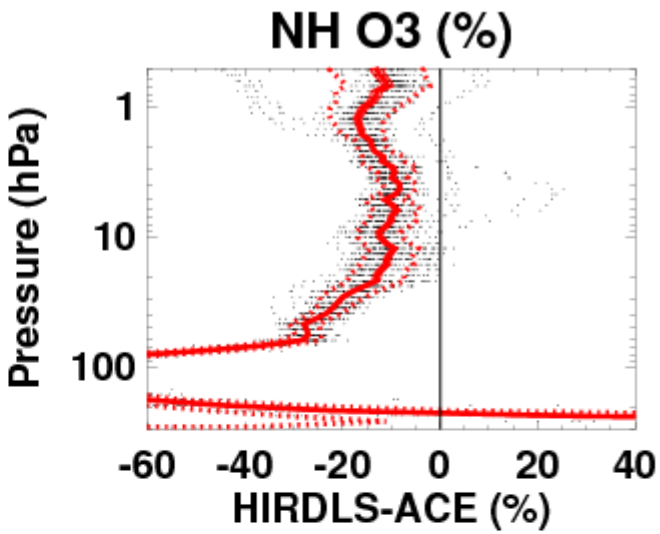


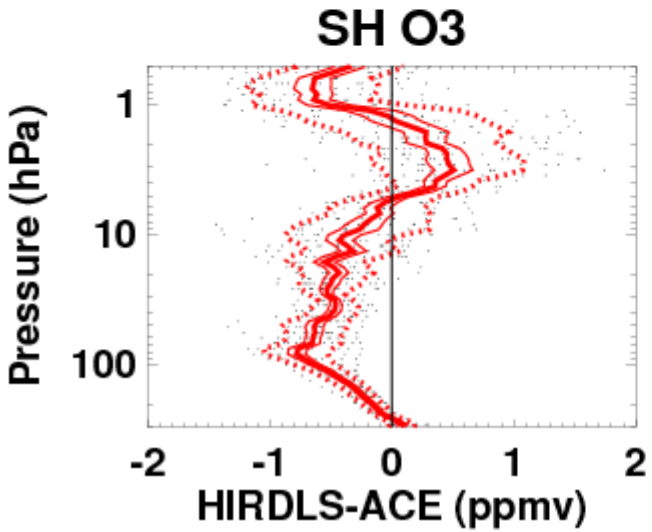


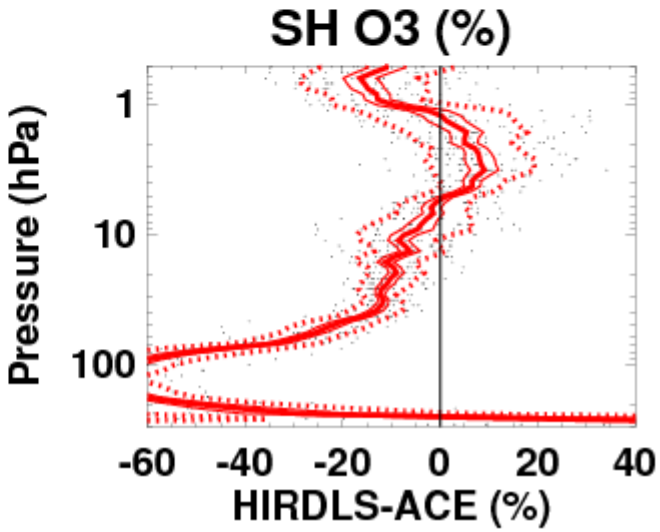
Average (solid) & 1-σ standard deviation (dotted)

HIRDLS-FTS Ozone Differences









Thick red:
Average

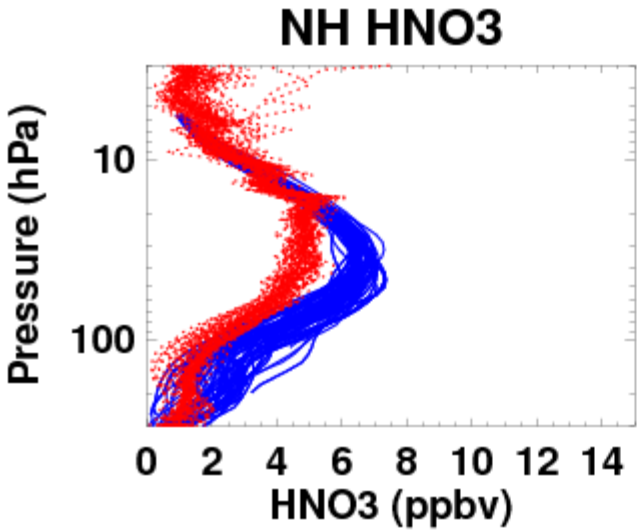
Dotted red:
1-σ distribution

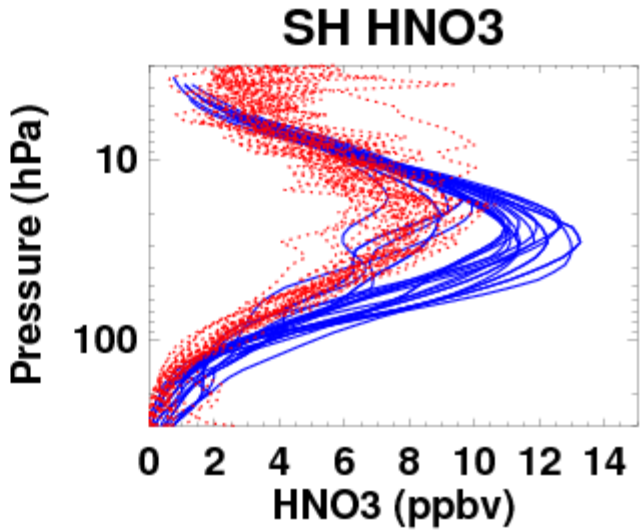
Thin red:
1-σ uncertainty
(often hidden)

Black points:
Individual
differences

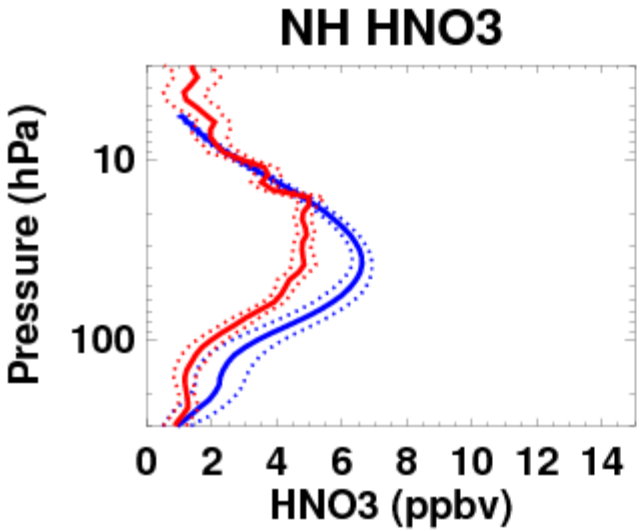
Nitric Acid (HNO_3)

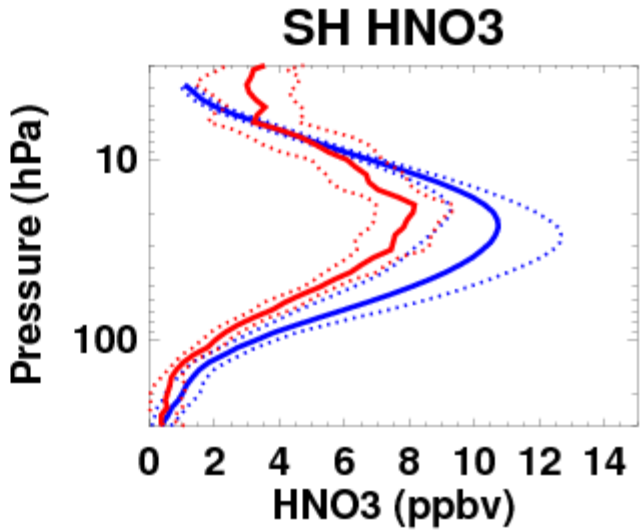
HIRDLS & ACE-FTS Nitric Acid Profiles





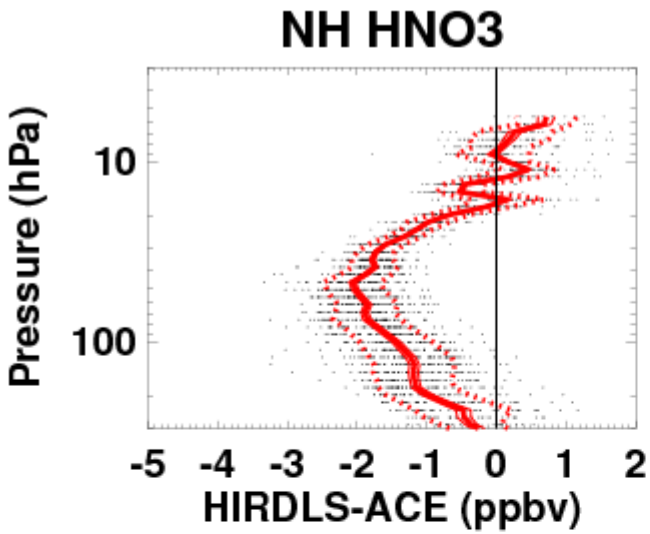
All Coincidences

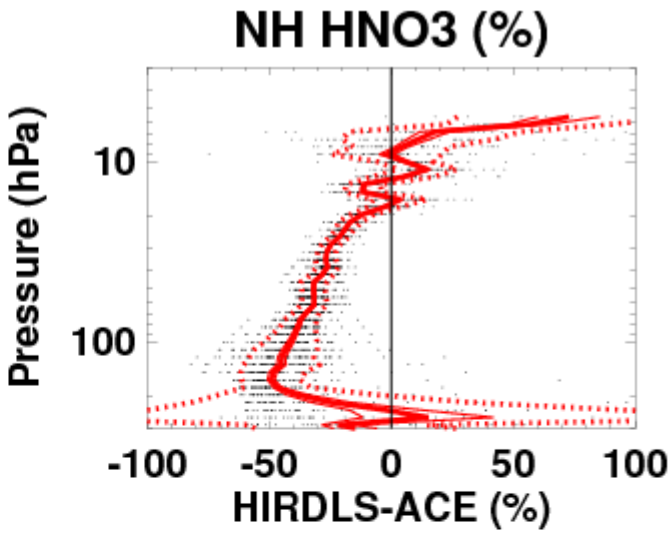


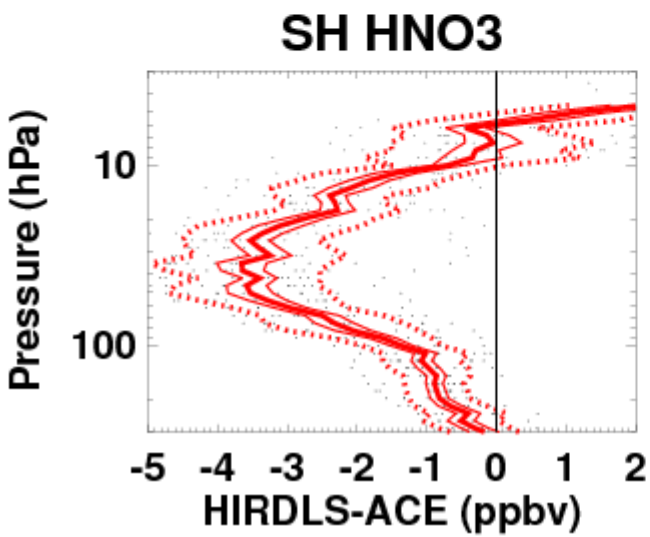


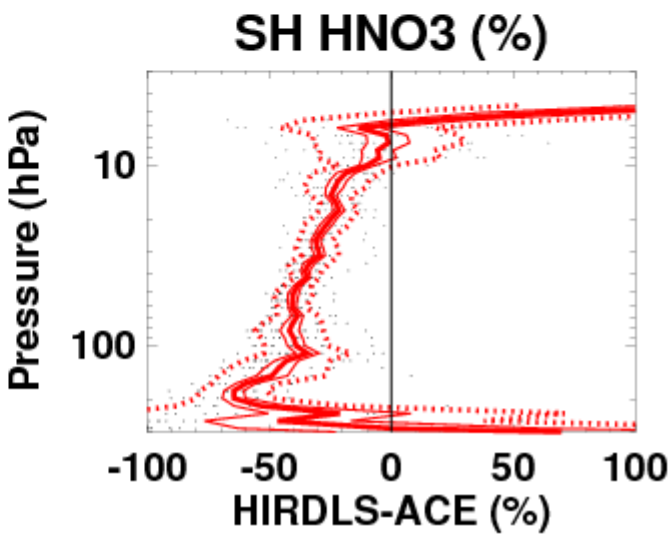
Average (solid) & 1-σ standard deviation (dotted)

HIRDLS-FTS Nitric Acid Differences









Thick red:
Average

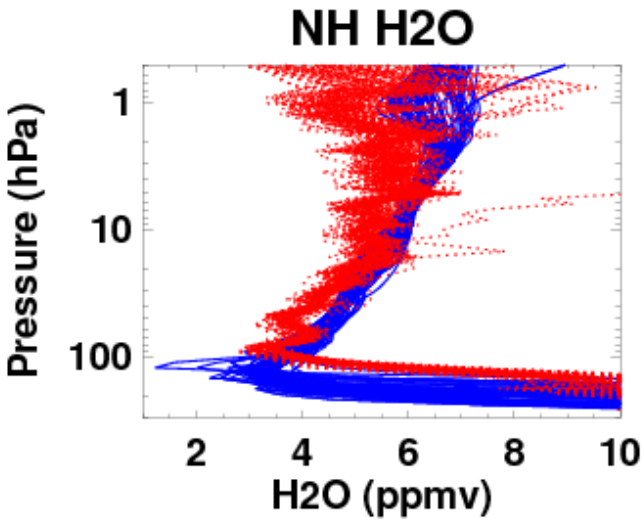
Dotted red:
1-σ distribution

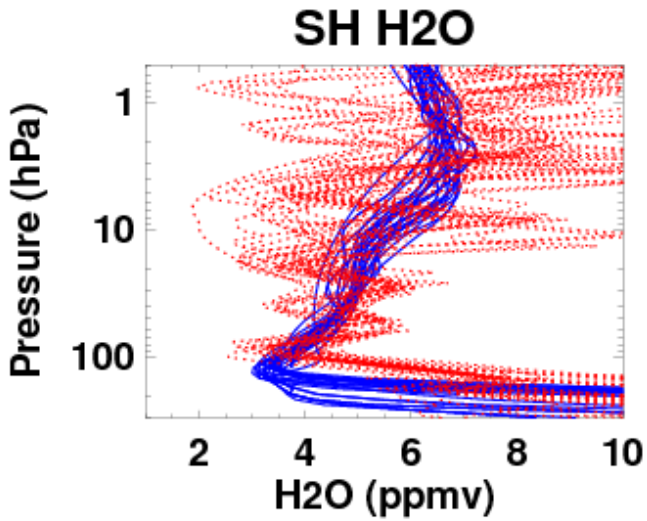
Thin red:
1-σ uncertainty
(often hidden)

Black points:
Individual
differences

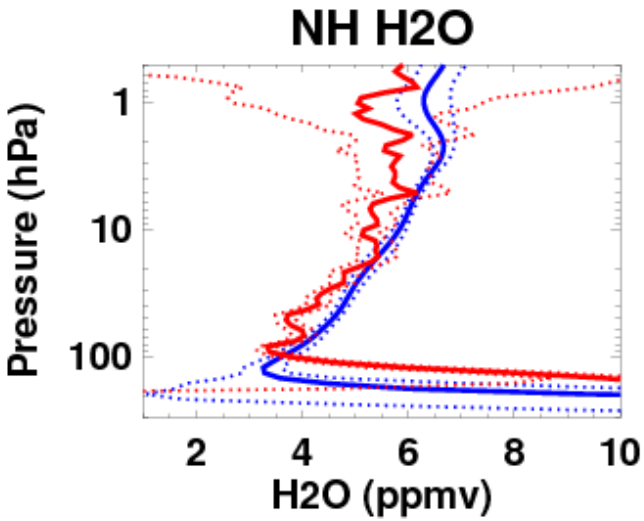
Water Vapor (H_2O)

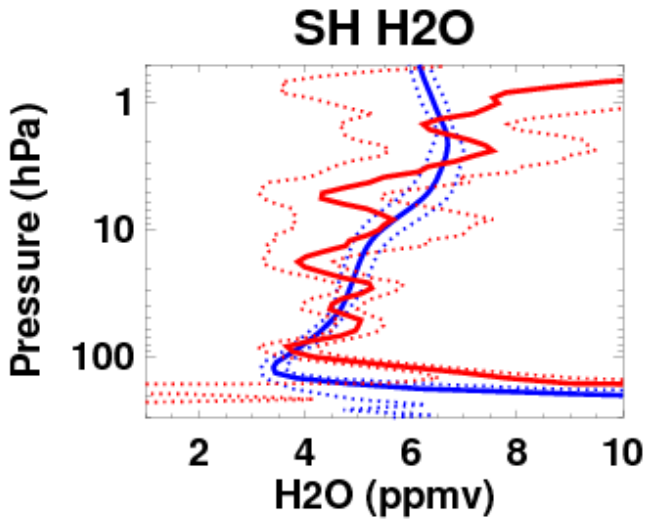
HIRDLS & ACE-FTS Water Vapor Profiles





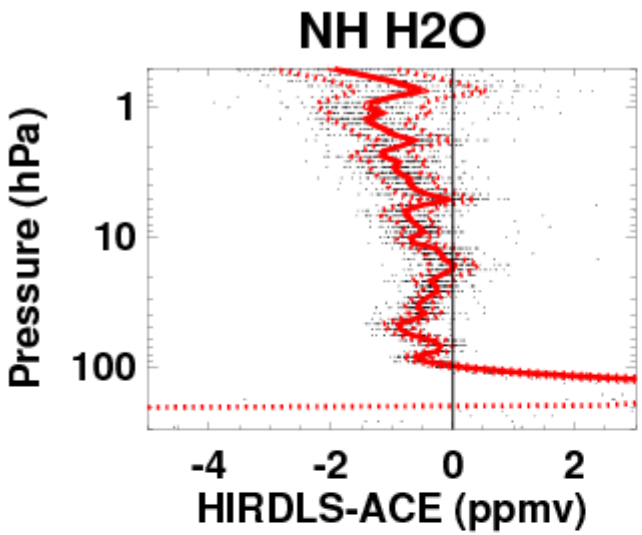
All Coincidences

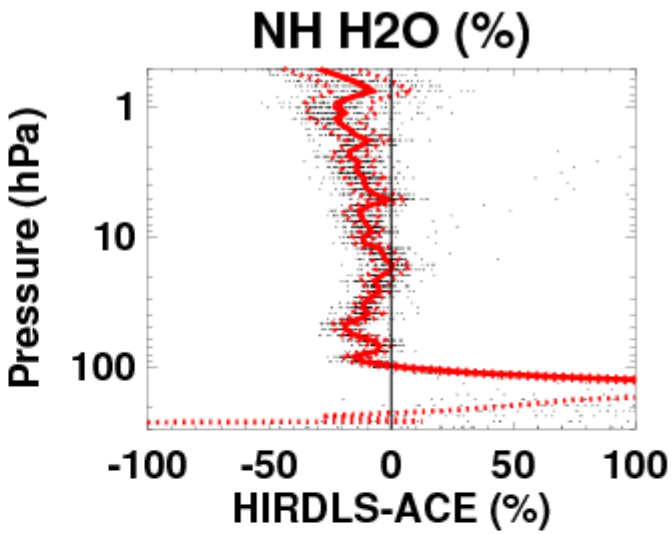


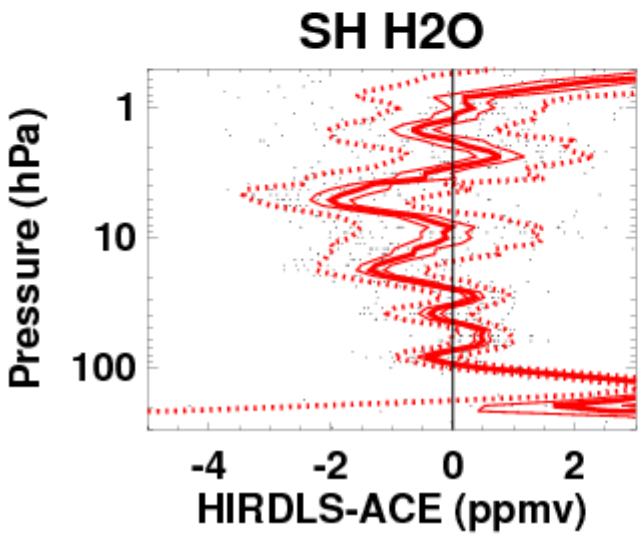


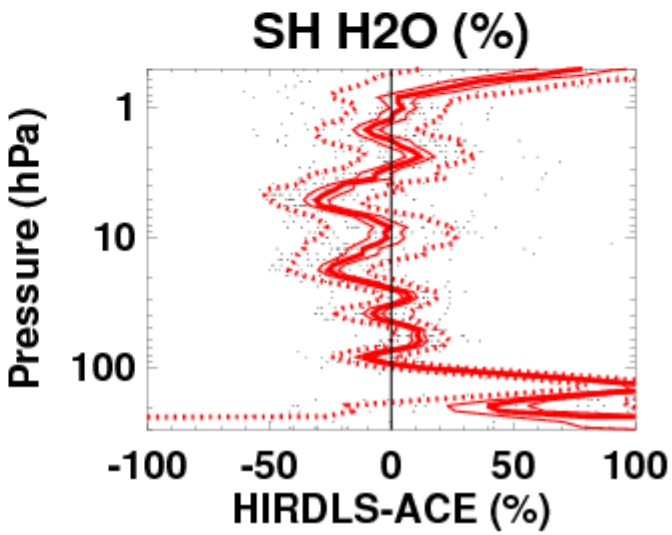
Average (solid) & 1-σ standard deviation (dotted)

HIRDLS-FTS Water Vapor Differences









Thick red:
Average

Dotted red:
1-σ distribution

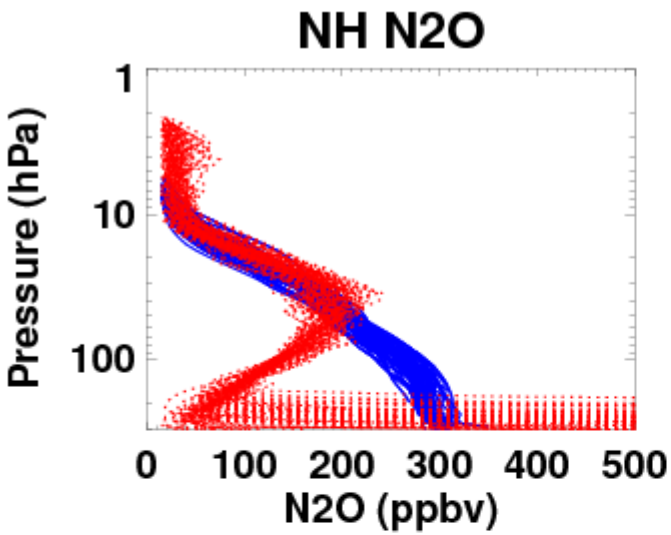
Thin red:
1-σ uncertainty (often hidden)

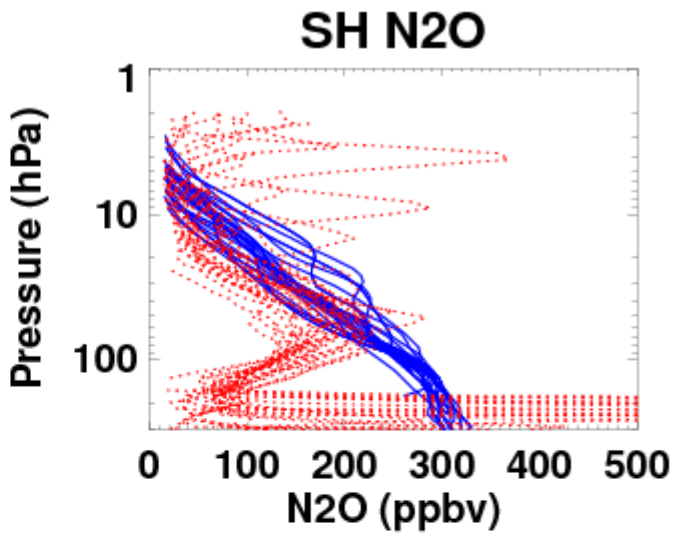
Black points:
Individual differences

Note: ACE is 0-10% high compared to HALOE

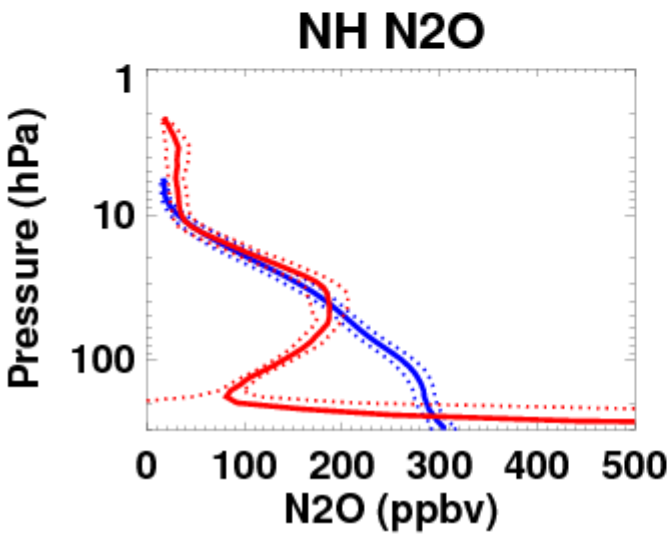
Nitrous Oxide (N_2O)

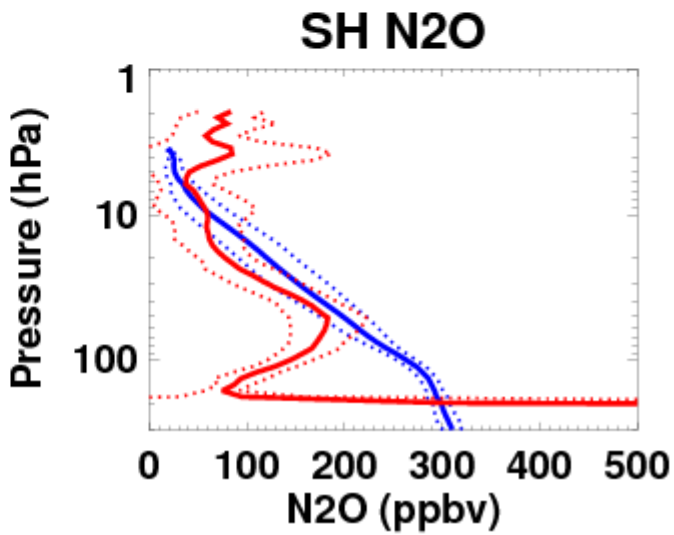
HIRDLS & ACE-FTS N2O Profiles





All Coincidences

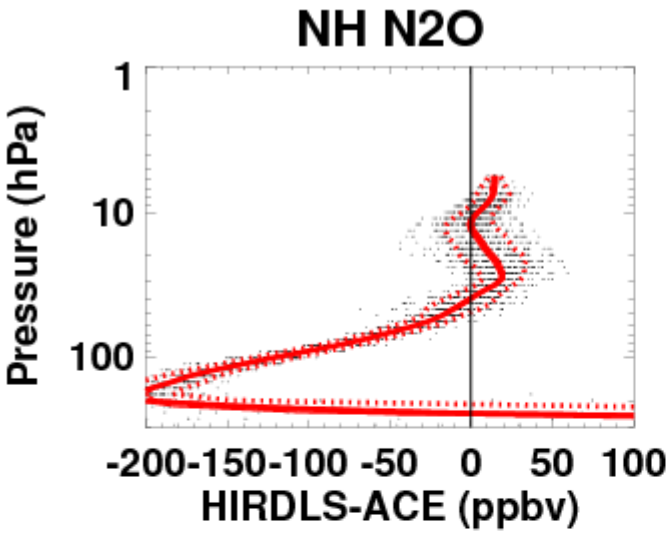


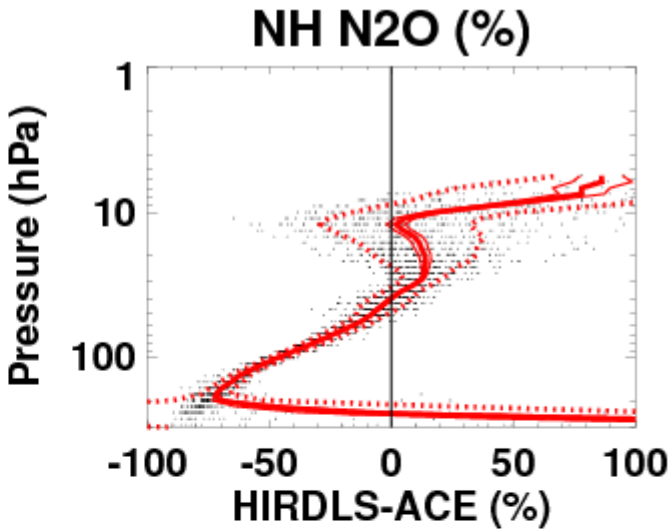


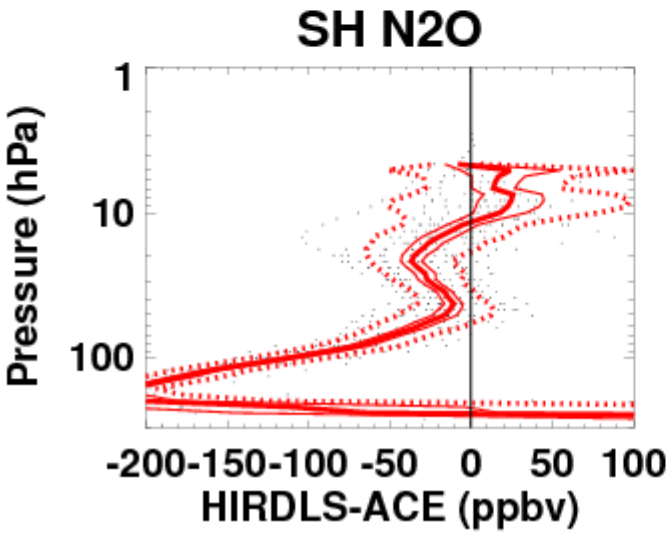
Average (solid) & 1-σ standard deviation (dotted)

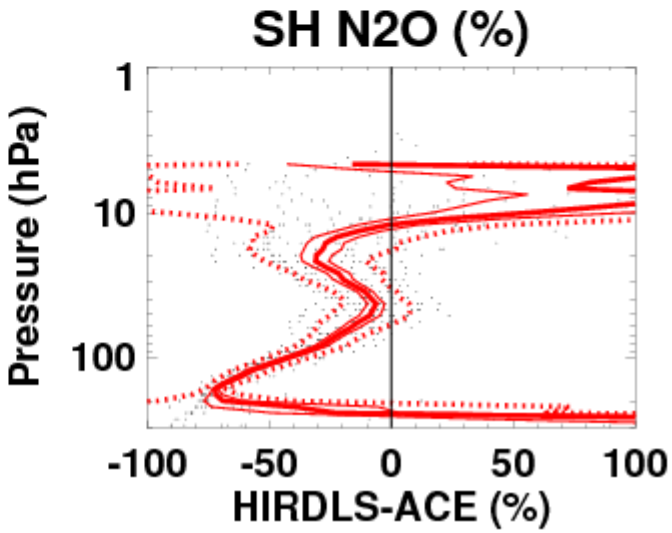
Used a low threshold of 1.5e-8 for N2O.

HIRDLS-FTS N2O Differences









Thick red:
Average

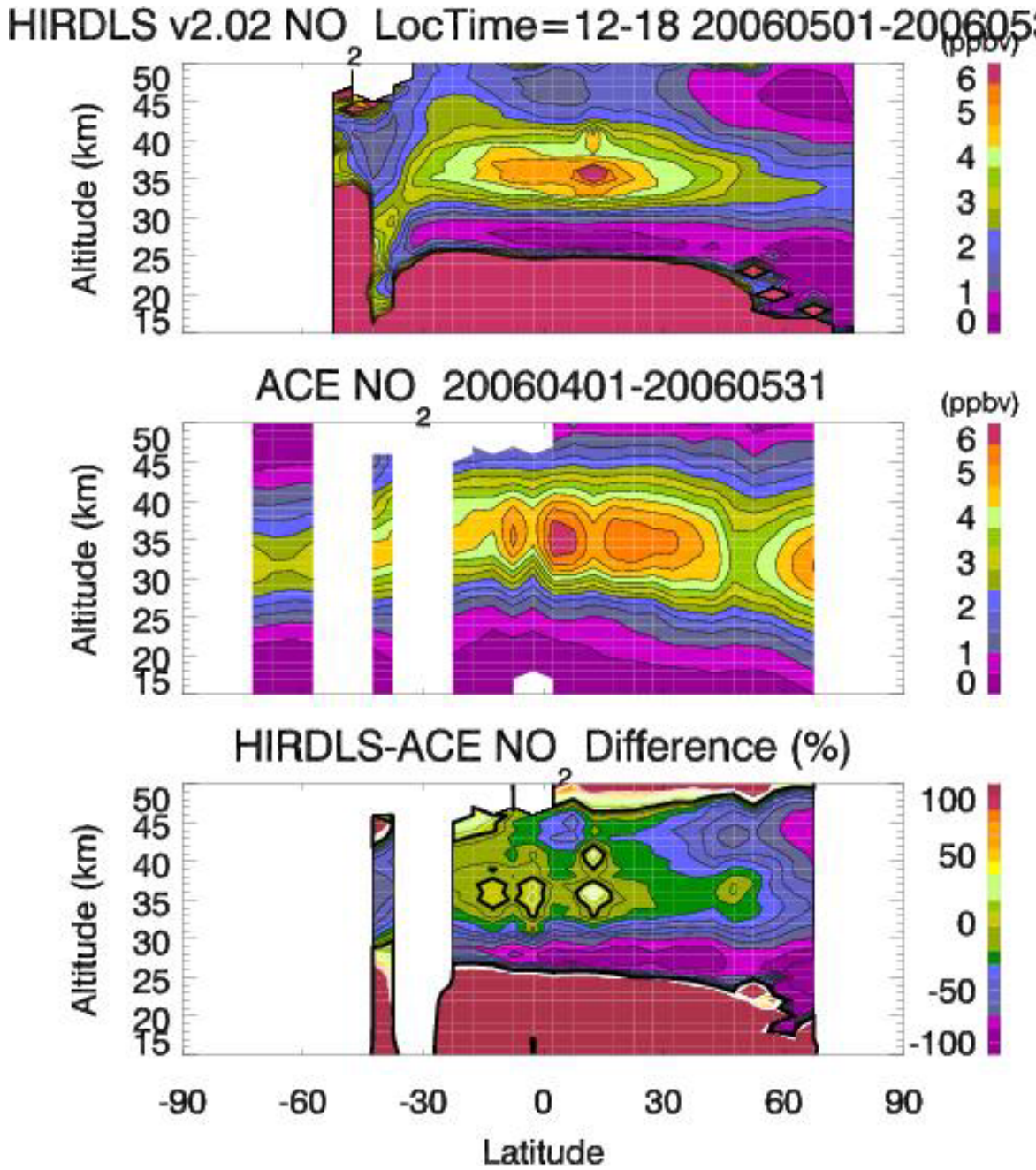
Dotted red:
1-σ distribution

Thin red:
1-σ uncertainty (often hidden)

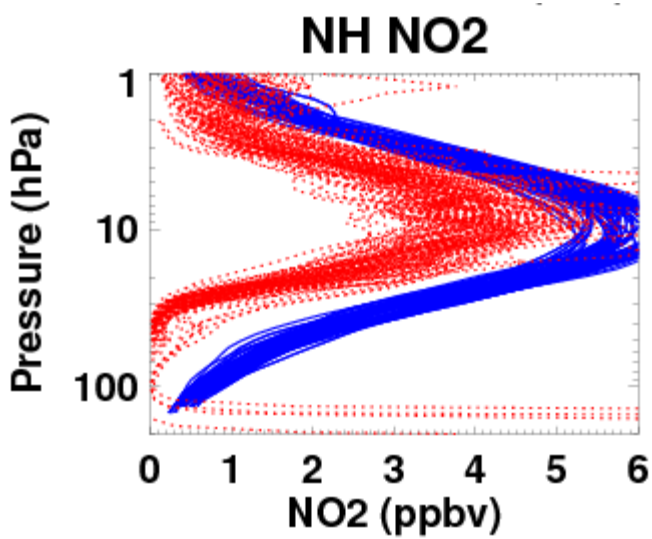
Black points:
Individual differences

Used a low threshold of 1.5e-8 for N2O.

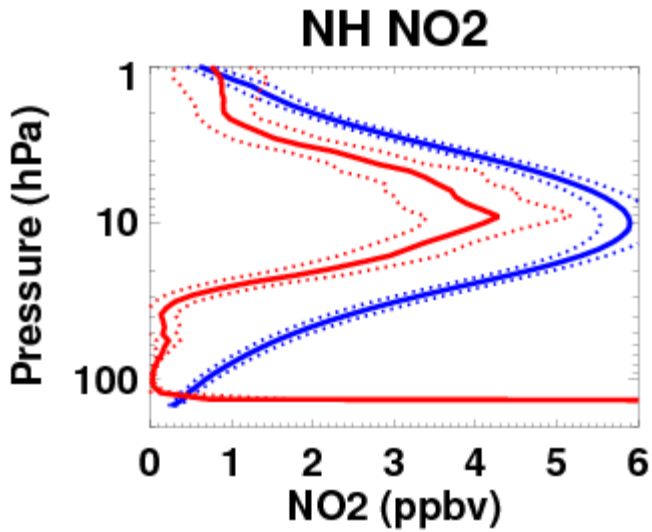
NO_2


HIRDLS v2.02 NO2 LocTime=12-18 20060501-20060531
(ppbv)
Altitude (km)
50
45
40
35
30
25
20
15
6
5
4
3
2
1
0
ACE NO2 20060401-20060531
(ppbv)
Altitude (km)
HIRDLS-ACE NO2 Difference (%)
100
50
0
-50
-100
-90
-60
-30
0
30
60
90
Latitude

HIRDLS & ACE-FTS NO2 Profiles

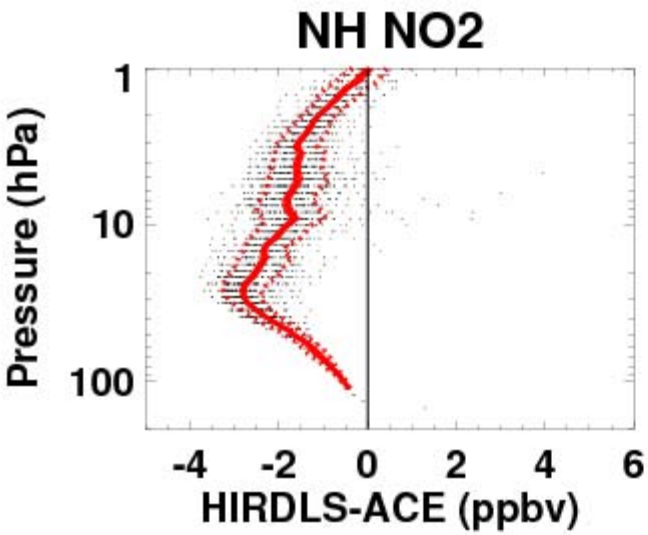


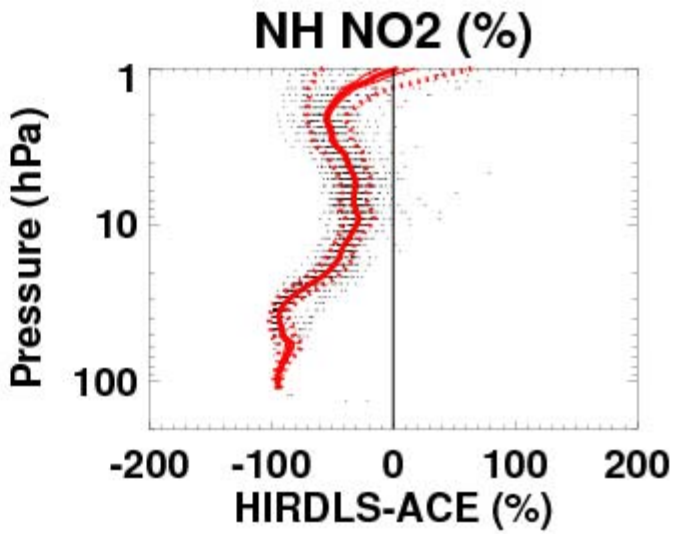
All Coincidences



Average (solid) & 1-σ standard deviation (dotted)

HIRDLS-FTS NO2 Differences





Thick red:
Average

Dotted red:
1-σ distribution

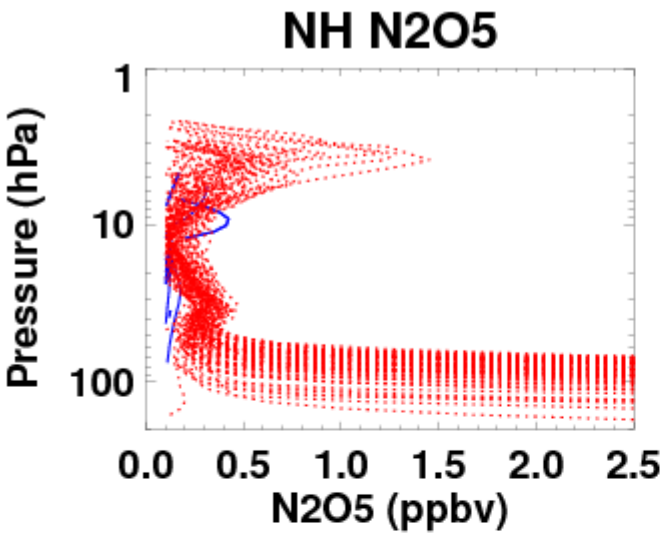
Thin red:
1-σ uncertainty (often hidden)

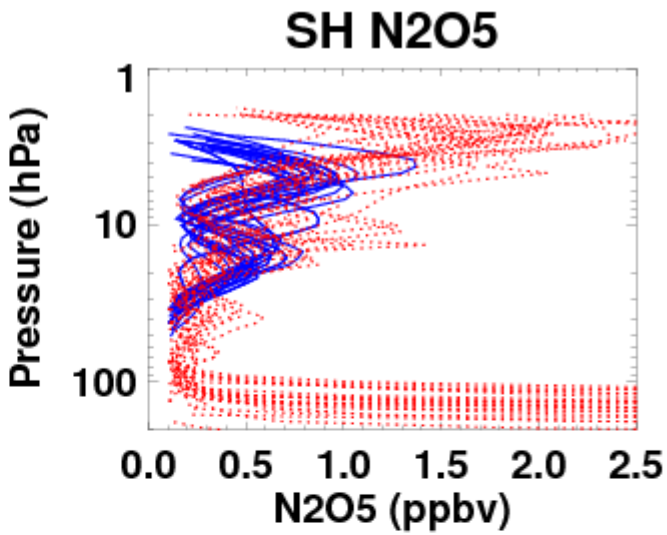
Black points:
Individual differences

Note: ACE is 0-10% lower than HALOE

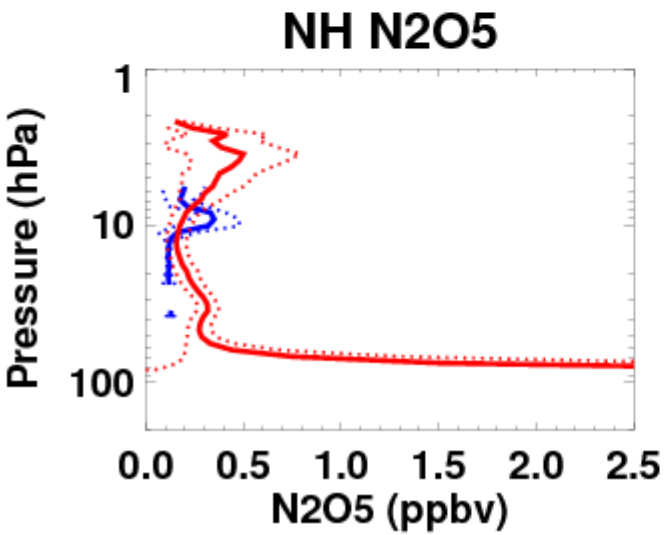
N_2O_5

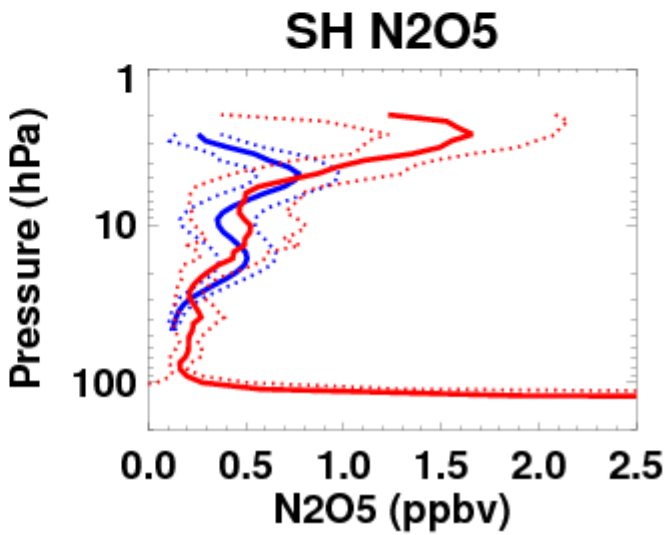
HIRDLS & ACE-FTS N2O5 Profiles





All Coincidences

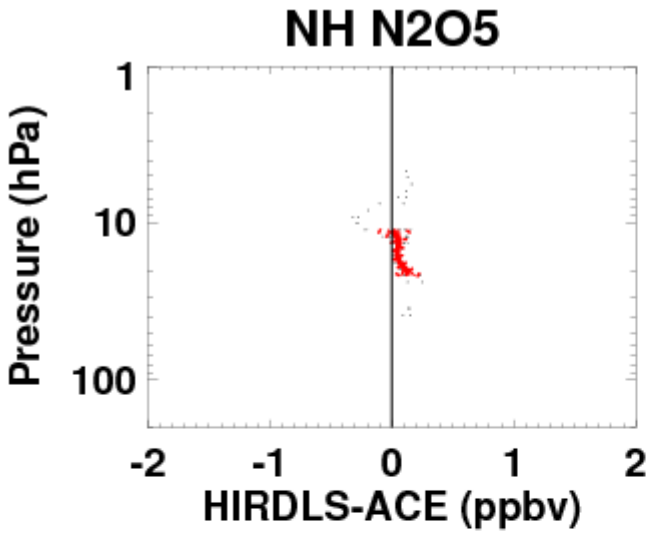


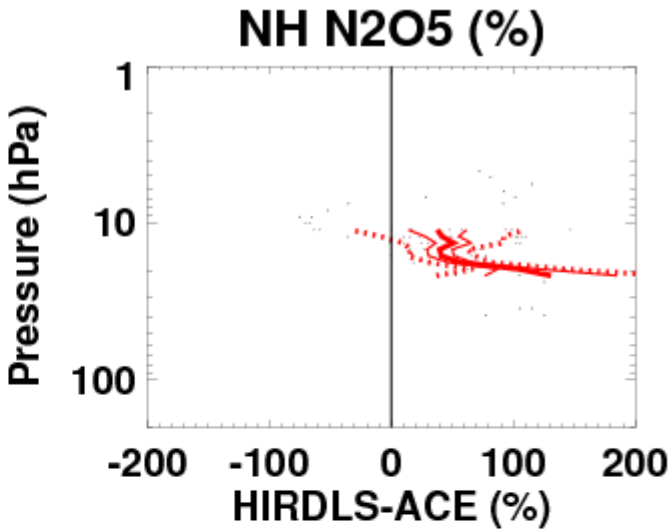


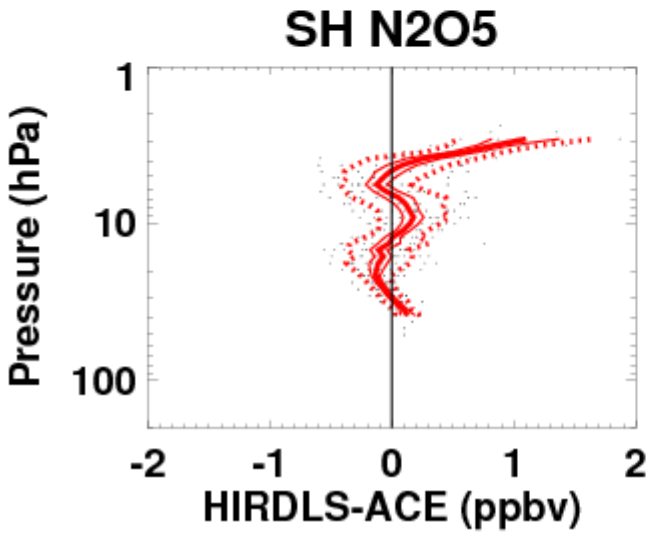
Average (solid) & 1-σ standard deviation (dotted)

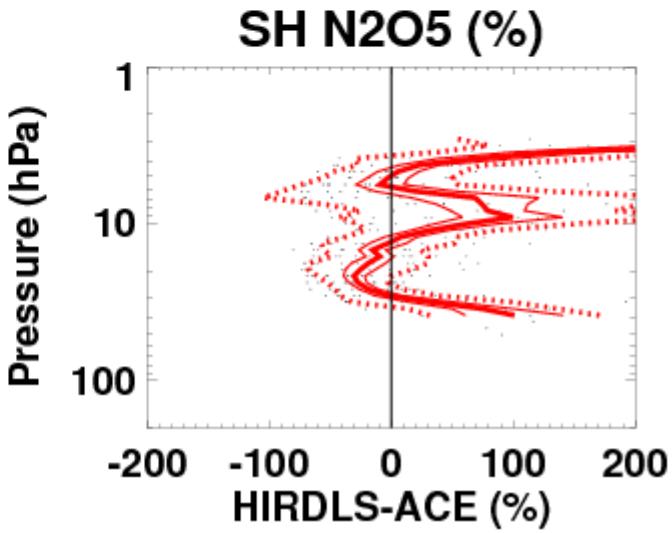
Used a low threshold of 1.e-10 for N2O5.

HIRDLS-FTS N2O5 Differences









Thick red:
Average

Dotted red:
1-σ distribution

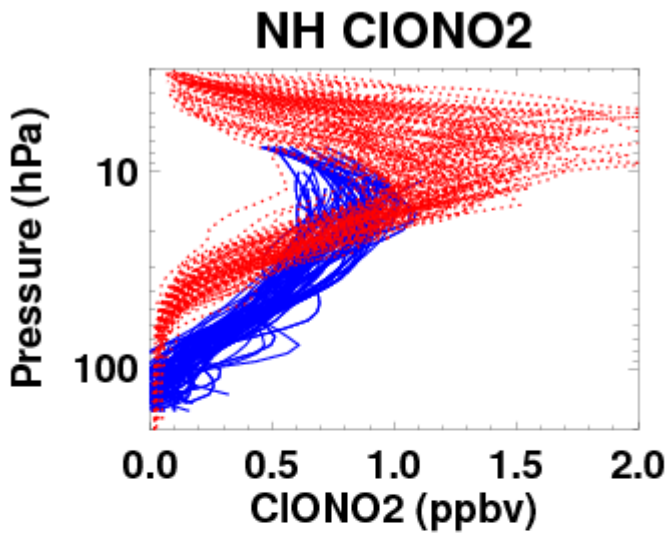
Thin red:
1-σ uncertainty (often hidden)

Black points:
Individual differences

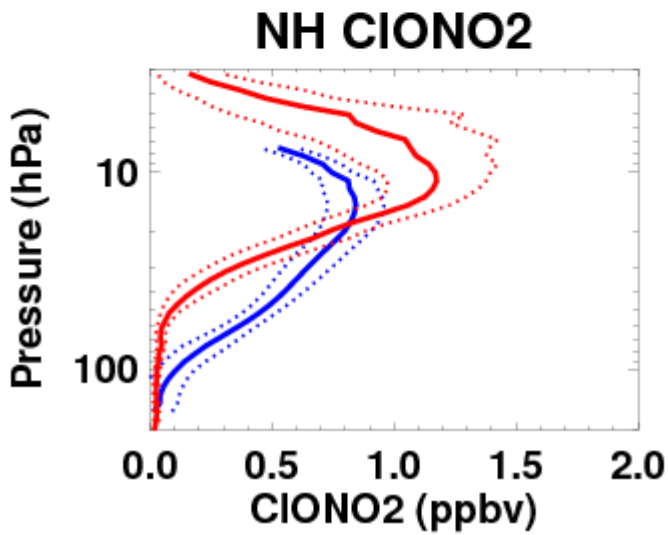
Used a low threshold of 1.e-10 for N2O5.

$ClONO_2$

HIRDLS & ACE-FTS ClONO2 Profiles

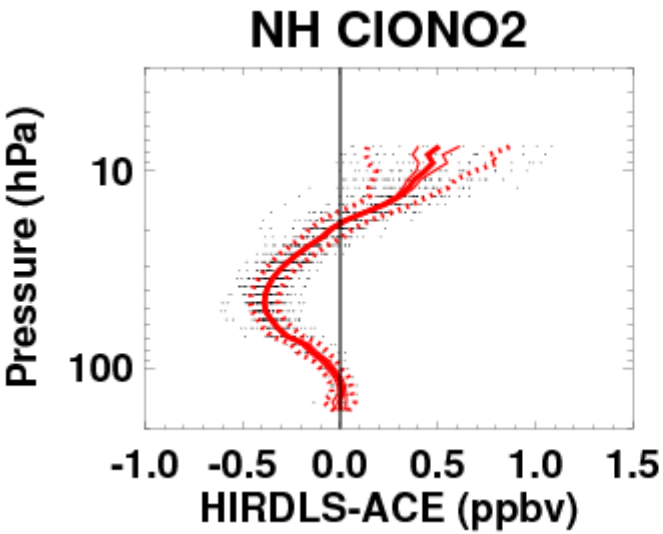


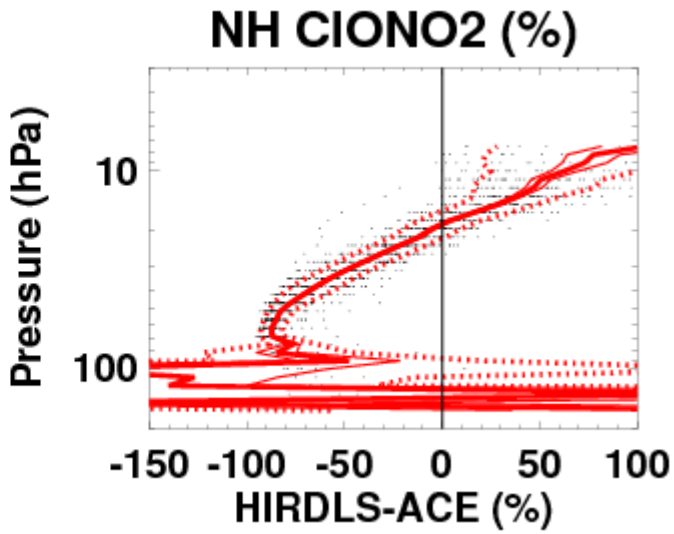
All Coincidences



Average (solid) & 1-σ standard deviation (dotted)

HIRDLS-FTS ClONO2 Differences





Thick red:
Average

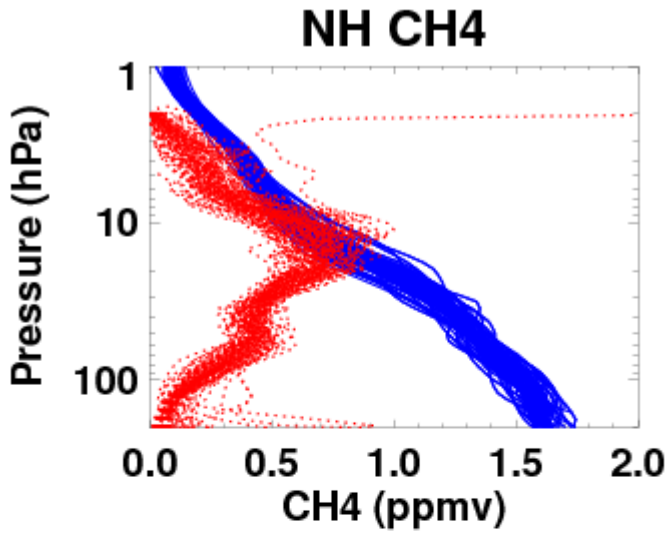
Dotted red:
1-σ distribution

Thin red:
1-σ uncertainty (often hidden)

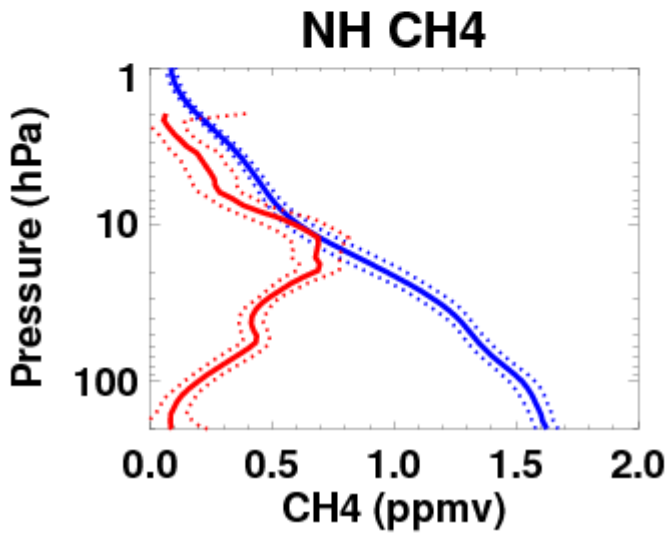
Black points:
Individual differences

Methane (CH_4)

HIRDLS & ACE-FTS CH4 Profiles

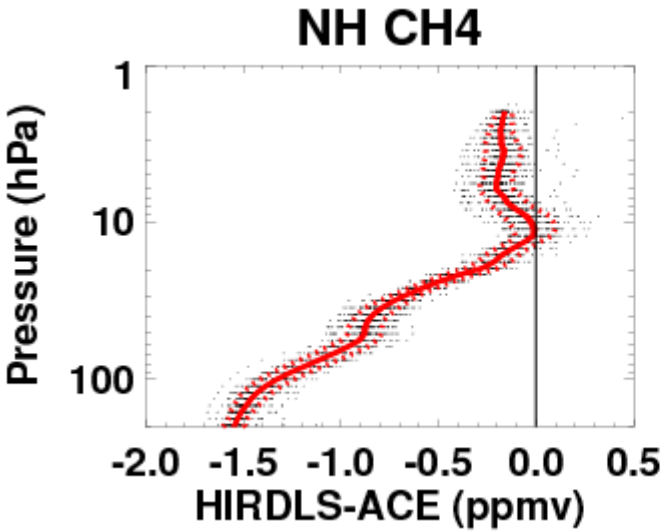


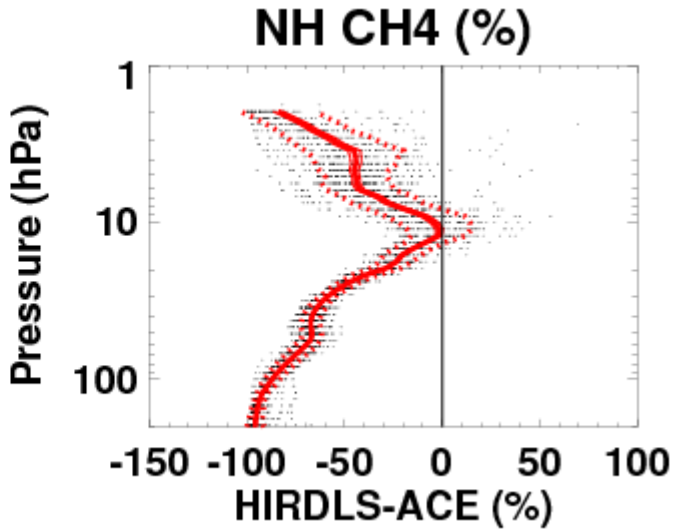
All Coincidences



Average (solid) & 1-σ standard deviation (dotted)

HIRDLS-FTS CH4 Differences





Thick red:
Average

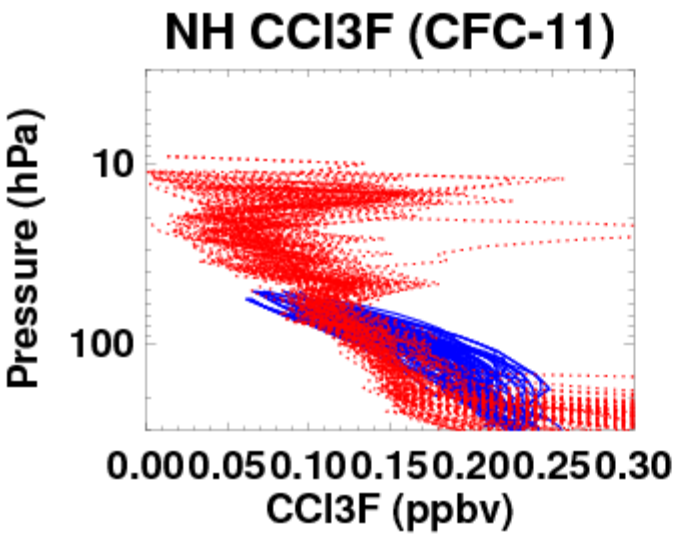
Dotted red:
1-σ distribution

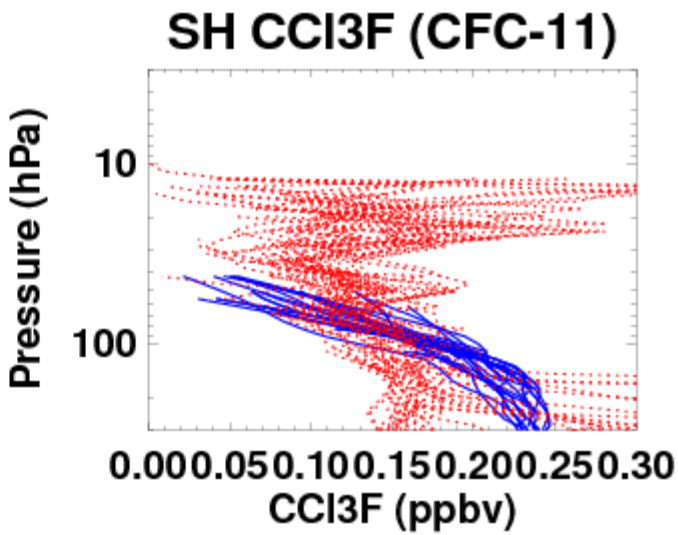
Thin red:
1-σ uncertainty (often hidden)

Black points:
Individual differences

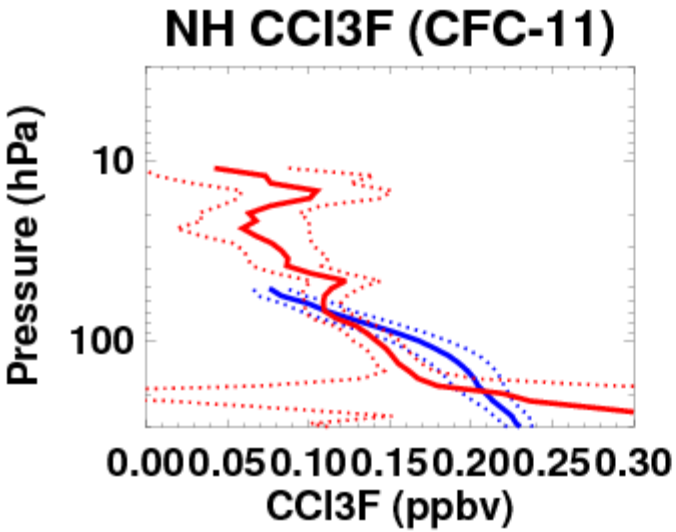
CFC-11 (CCl_3F)

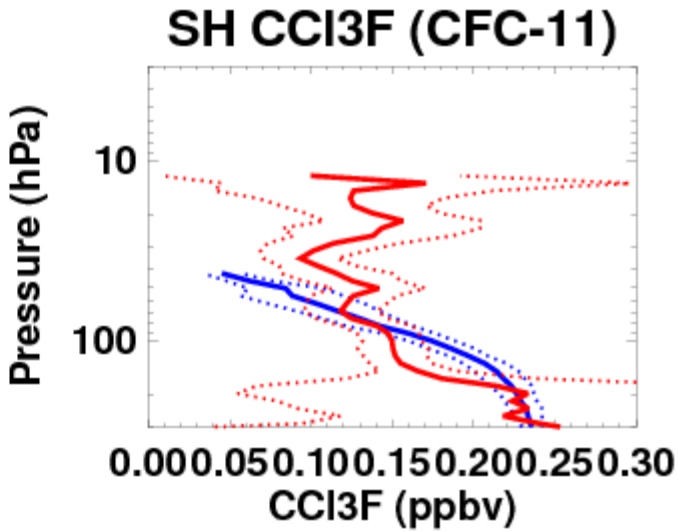
HIRDLS & ACE-FTS CFC-11 Profiles





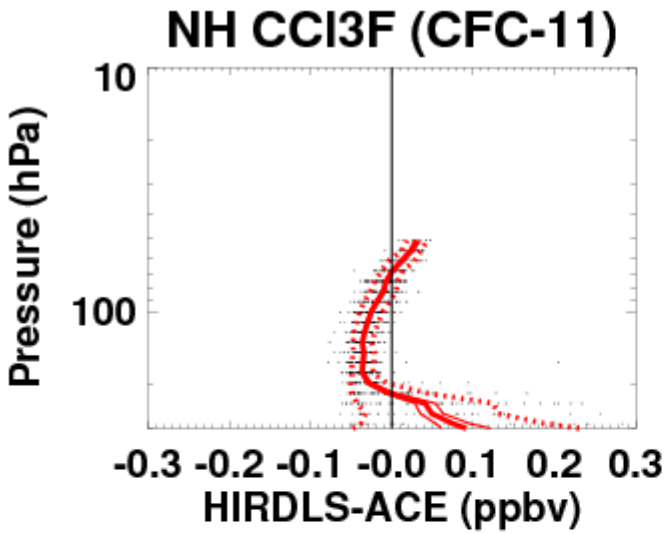
All Coincidences

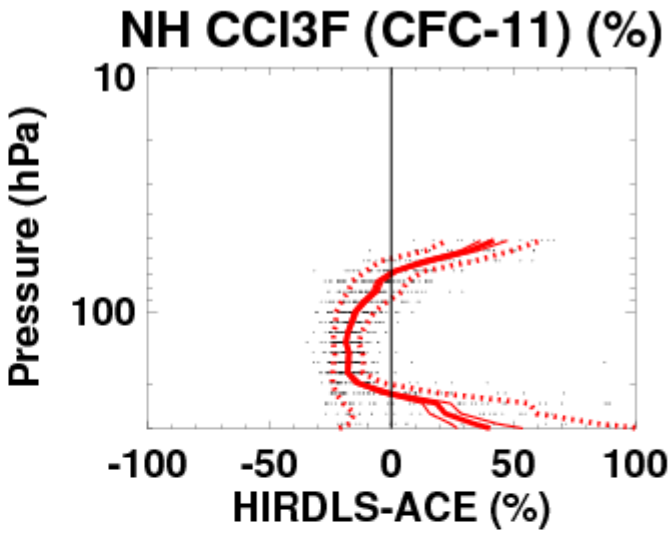


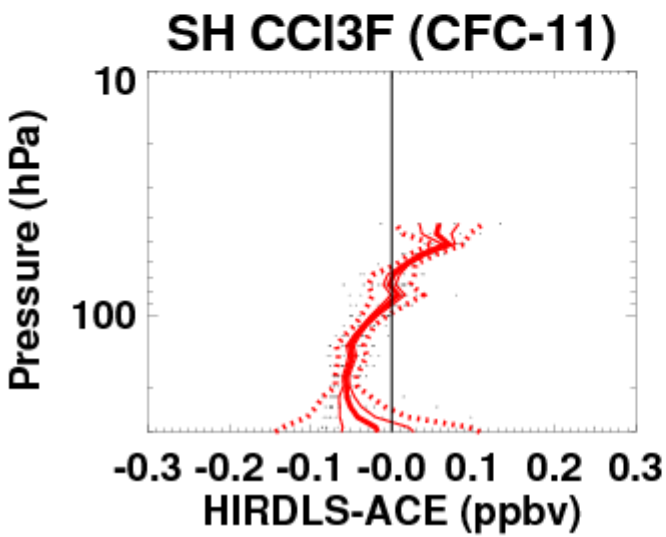


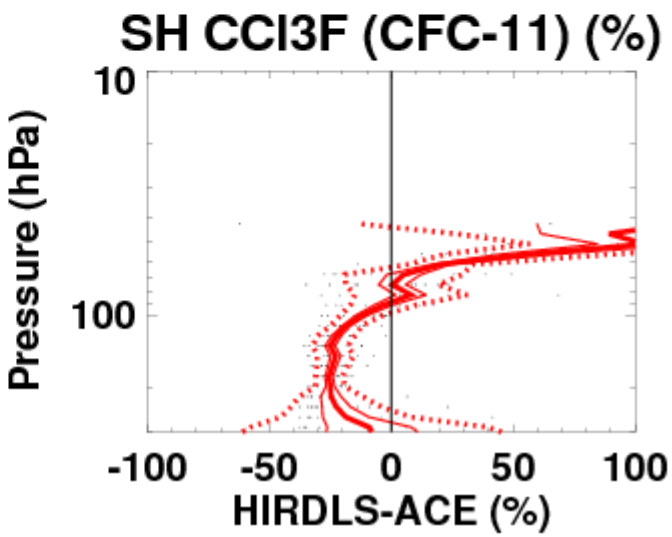
Average (solid) & 1-σ standard deviation (dotted)

HIRDLS-FTS CFC-11 Differences









Thick red:
Average

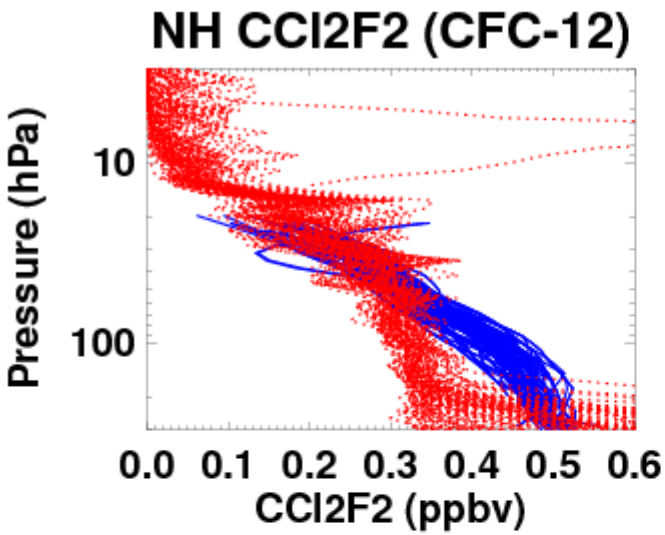
Dotted red:
1-σ distribution

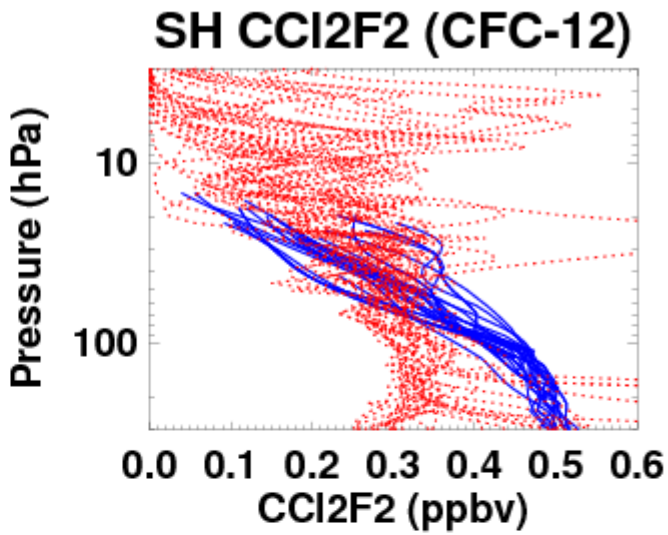
Thin red:
1-σ uncertainty
(often hidden)

Black points:
Individual
differences

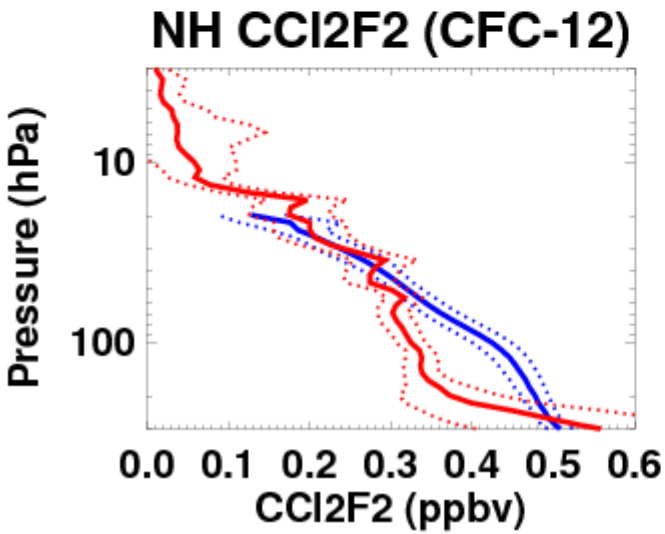
CFC-12 (CCl_2F_2)

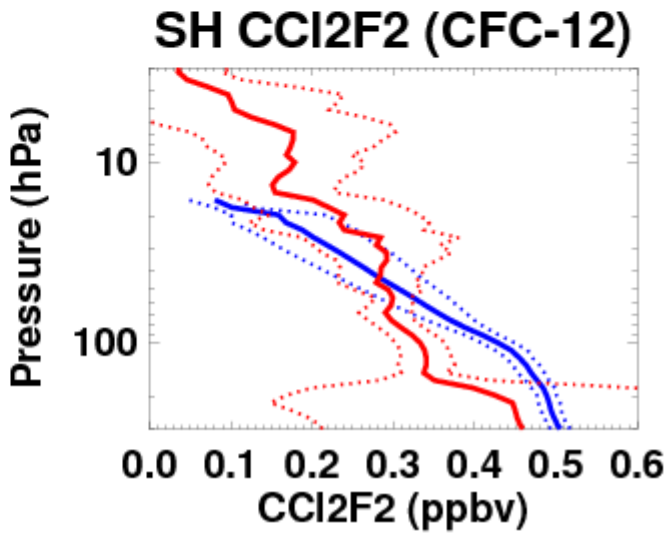
HIRDLS & ACE-FTS CFC-12 Profiles





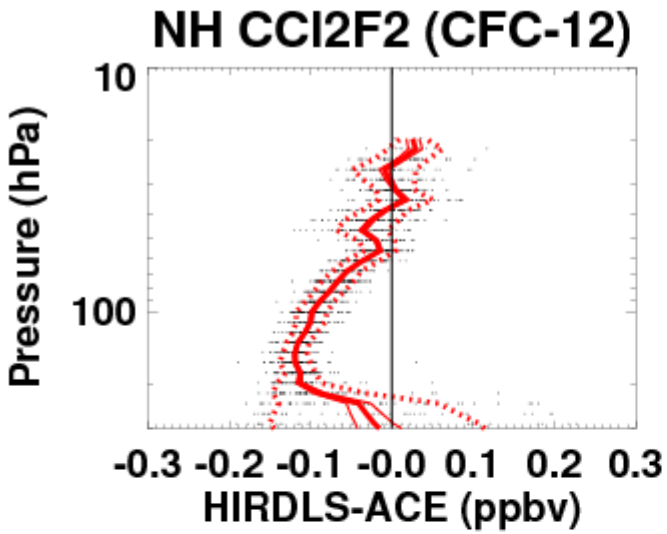
All Coincidences

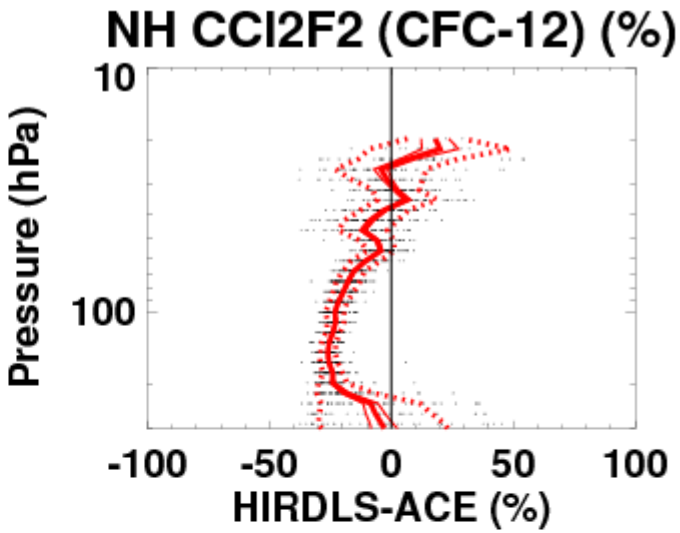


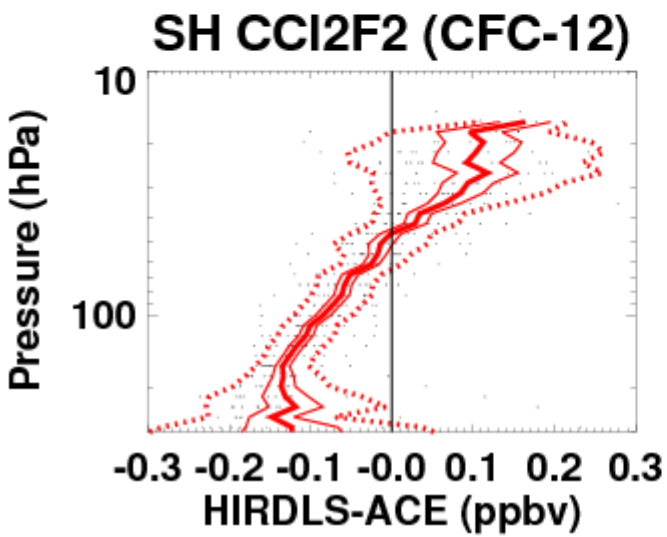


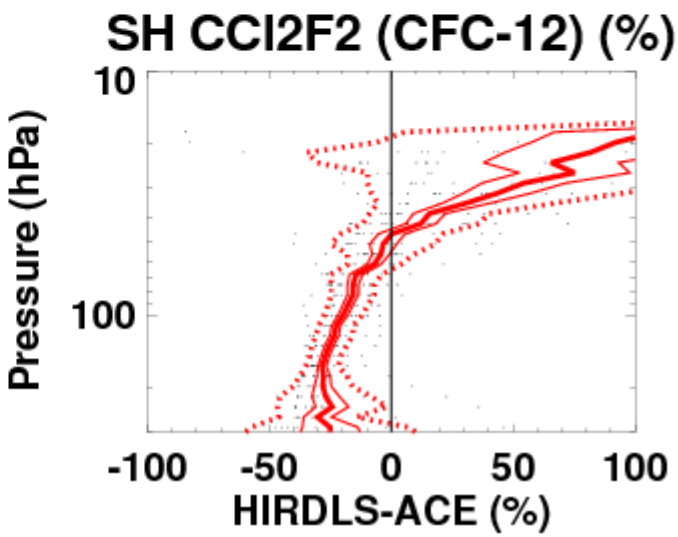
Average (solid) & 1-σ standard deviation (dotted)

HIRDLS-FTS CFC-12 Differences









Thick red:
Average

Dotted red:
1-σ distribution

Thin red:
1-σ uncertainty (often hidden)

Black points:
Individual differences